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EDITORIAL

THIS month sees the appearance of the 1961 edition of Skinner's "Mining Year Book," the 75th consecutive year of its appearance. The book contains complete particulars of 1,000 of the principal South African, Rhodesian, West African, Australasian, Far Eastern, Canadian, American, and other mining and metal companies operating in all parts of the world and covers all branches of the mining industry. Also included are a useful series of tables, a guide to manufacturers and suppliers of equipment, as well as purchasers and dealers in ores and minerals. There is also a professional directory.

PREPARED by the Mineral Resources Division of Overseas Geological Surveys the well-known "Statistical Summary of the Mineral Industry (World Production, Exports, and Imports, 1954–1959)" was published last month. For the period indicated the new edition shows world production, exports, and imports of all important economic minerals, metallic and non-metallic, including the mineral fuels coal and petroleum, and contains over 200 tables relating to more than 60 commodity groups. Tables for cobalt, copper, lead, tin, and zinc show production of primary metal, as well as production of ore in terms of its metal content, but production of secondary metal is excluded, as far as possible, although, where important, it is given in footnotes. The less common minerals—such as, those of lithium, niobium, tantalum, titanium, and uranium—are included.

OIL consumption in the United Kingdom rose by 16·9% in 1960, as compared with the previous year, and reached over 42,500,000 tons (excluding bunkers for ships engaged in the foreign trade) according to final figures now issued by the Petroleum Information Bureau. Among major products, fuel oil consumption again showed the greatest increase, being more than a quarter as much again as in the previous year and reaching 17,437,805 tons. Additional quantities of this product were also consumed in the oil refineries. Gas/diesel oil deliveries were up by 13% but use of this product in gas works is declining and is being partially replaced by light distillate feedstock and refinery gases.

IN view of the call for an international agreement for regulating the production of lead and zinc at the third meeting of the International Study Group for those metals held in Mexico City in March it is interesting that new uses for these metals, particularly lead, should be discovered. At the 33rd annual meeting of the Lead Industries Association held earlier this month in Chicago it was reported that lead has several important roles to play in "solid state physics," such as transistors, masers, and many other electronic and nuclear devices. The Association heard several talks covering piezo-electric lead zirconate-titanate and its use in sonar, ultrasonic cleaning and petrol engine ignition, pearlescent lead pigments, thermo-electric lead-telluride, and a new lightweight structural material—glazed lightweight clay blocks. Also outlined was the future of lead telluride in thermo-electric power generation. Thermo-electricity—the ability of a material to generate current when heat is applied—has the design advantage of providing power from heat without moving parts. A conversion efficiency from heat to electricity of about 9% makes these power packages very attractive in "waste heat" applications and for portable power for areas remote from power lines, it was pointed out. One big manufacturer is at present vigorously developing a thermo-electric power pack to supply power from waste furnace heat to run fans or pump equipment in home heating systems. The company's project is being supported by 12 gas utilities, it is reported, and their aim is to develop a mass-produced package at a cost of less than \$1 per watt. The speaker also mentioned that Westinghouse is supplying large thermo-electric generators for military use.

REPLYING to the toast of "The School" at the annual dinner of the Camborne School of Mines earlier this month the principal, Mr. R. A. Gorges, reminded

those present that the C.S.M. was the most senior technological institution in Cornwall, but said that there was urgent need for extension and modernization. The school would, he said, like to find itself able to concentrate all its activities in Camborne and not have to divide its students with the Technical College at Condurrow. With the goodwill of industry and the help of the Ministry of Education, to whom they were most grateful for continued support, they hoped to attain their ends, with more and more students coming to the school. Extreme difficulty was being experienced in obtaining suitable accommodation and he felt the school's claim for a hostel was extremely good. Previously Mr. J. G. Harries, the county's Secretary for Education, had said that he was entirely happy that there should continue to flourish in Cornwall a number of private schools, of which Camborne School of Mines should be one. He was confident that if the school needed assistance from Cornwall Education Committee this would be very carefully considered.

A toast to the Institution of Mining and Metallurgy was proposed by Mr. A. C. Owen, chairman of the court of governors, and acknowledged by Mr. J. B. Simpson, a vice-president of the Institution.

IT was reported earlier this month that drilling operations designed to investigate the nature and extent of uranium mineral occurrences on the Solway coast of Kirkcudbrightshire had been completed. The exploration was begun in January this year by the Atomic Energy Division of the Geological Survey on behalf of the United Kingdom Atomic Energy Authority. The investigations, it is stated, proved the existence of sporadic uranium over a distance of 2 miles parallel to the coast and extending to a depth of some 200 ft. The overall content of uranium ore, however, proved too small to warrant the extension of tests in depth at the present time and no further work is contemplated. It is evident, however, that regional exploration in this country is to be continued by the Department of Scientific and Industrial Research, since it was announced last month by Hunting Surveys, Ltd., that they had been awarded a contract for carrying out an airborne geophysical survey over the western English Channel, the isles of Scilly and Lundy, and the sea area south-west of the Bristol Channel, this survey being part of a programme being undertaken by the Geological Survey. It will be tied magnetically into the previous airborne magnetometer survey over Devonshire and Cornwall already carried out. The navigation and position fixing over sea areas will, it is stated, be controlled by the Decca Navigator network. The work necessitates flying approximately 14,000 line miles of magnetic profile, the reduction of all the magnetic data obtained on these flights, and production of total intensity magnetic maps at a scale of 1 in. to 1 mile.

The Commonwealth Mining and Metallurgical Congress

The past month has seen the meeting of the Seventh Commonwealth Mining and Metallurgical Congress in South Africa and elsewhere in this issue our Johannesburg correspondent describes proceedings during the opening phases. Another correspondent, writing from South Africa, pays tribute to the " splendid and unobtrusive organization " which resulted in so smooth a start to the programme, saying that there might well be a danger that visiting delegates would not realize what a great amount of preliminary work had been put in on their behalf by the Executive Committee and the many sub-committees. The contrast between the effectiveness and certainty of man's planning and the still powerful vagaries of Nature was particularly brought home, he says, to those delegates—including Sir George Davenport, the Congress Vice-President from Southern Rhodesia—who were prevented by poor visibility and low cloud from landing at the Jan Smuts Airport and variously returned to Salisbury or were diverted to Durban or Bloemfontein.

The programme issued to delegates followed almost exactly that forecast in the Second Information Brochure. After the formal opening proceedings the general stage framework was set by the four introductory papers, Mr. C. B. Anderson's address in the morning on " The Organization and Management of the Gold Mining Industry in South Africa " and the three papers in the afternoon—" The Economy of the Union of South Africa," " An Outline of South African Geography," and " Outline of the Geology

of South Africa" by Dr. W. J. Busschau, Professor S. P. Jackson, and Professor Gevers, respectively. On the Wednesday the scenery was brought on to the stage for the first act by five general information papers in the morning and in the afternoon the first technical papers divided into the three groups "Mining and Geology," "Metallurgy," and "Engineering."

The Congress managers then showed their good judgment in that, having provided the delegates with background information and some knowledge and made them keen for more, they devoted Thursday to visits to the Witwatersrand gold mines. Few delegates can have failed to make use of this opportunity, it is thought, 12 mines participating in the programme, which was designed to give a cross-section of the main activities of a Witwatersrand gold mine with emphasis on the training and employment of African labour. Visits underground were included and delegates were royally entertained to lunch by the various mine managements.

Friday morning saw a resumption of the technical papers—taken in two groups, the first covering asbestos, copper, lead, zinc, tin, and antimony mining in South and South-West Africa and the second metallurgical research, the production of ferro-alloys and of iron and steel, manganese, and the recovery of ilmenite, rutile, and zircon at Umgababa. The afternoon saw the first exodus of delegates taking part in the main tours.

With the Chamber of Mines cocktail party at Congress Headquarters on Tuesday, the Mayoral cocktail party and supper at the University on Wednesday, and much private hospitality the Congress was already more than fulfilling the hope expressed by the President at the inauguration ceremony that South Africa would provide a technical interest and a welcome that would live in the memories of the delegates.

The correspondent who provided these notes went on to visit South-West Africa in order to look at activities at Oranjemund and Tsumeb. Visits were also paid to the Etosha pans. It is hoped to conclude this account of a remarkably successful Congress, held in somewhat difficult political circumstances, in our June issue.

It has now been announced that Sir Ronald Prain, Chairman of the Rhodesian Selection Trust Group of companies, has been appointed Chairman of the Commonwealth Council of Mining and Metallurgical Institutions in succession to Lord Baillieu. At the time of writing delegates are in Northern Rhodesia—for which Territory Sir Ronald was the Congress's regional vice-president.

London Metal Exchange

From time to time since the London Metal Exchange was re-opened after the war there have been many proposals for reconstruction. Members have long suffered from space restrictions and other inconveniences, particularly the acoustics at the "ring". Following discussions it was finally decided to go ahead, care to be taken to retain many of the distinguishing traditional features the Exchange possessed. Now the new Exchange is a reality, the recontructed building having been opened on April 28 by the Lord Mayor of London, Sir Bernard Waley-Cohen. The Rt. Hon. Iain Macleod, M.P., Secretary of State for the Colonies attended a dinner given by the London Metal Exchange on April 25 to mark the occasion.

The most prominent feature of the Metal Exchange, the ring itself, has been retained and successfully renovated, while the area incorporating the rooms has been adapted from a single into a three-storey building. Offices have been built on the two new floors above the rooms, the "open plan" design enabling them to be used as a bridge between the two premises occupied by one well-known company within the Exchange building. A clock-controlled system replaces the manually-operated push-bell to indicate the end of trading periods, but trading sessions are still divided into recurrent periods of five minutes for each of the four metals—copper, tin, lead, and zinc, although the end of a trading period is now signalled by a master clock controlling a number of "slave" clocks. This system is supplemented by illuminated panels at both ends of the Exchange to indicate the metal traded in at any one time.

Among the many other new innovations is a lamp-signalling device which automatically informs members or their clerks of telephone calls, while the telephone booths have been re-arranged to bring them nearer to the ring. Indeed it is now evident that the reconstruction of the Exchange has been more thorough than was originally foreseen, but that a just balance has been preserved between the good of the old and the best of the new.

MONTHLY REVIEW

Introduction.—Until agreement can be arranged between the Powers on matters of disarmament and until a greater degree of stability in affairs in Africa and the Far East has been reached business affairs are conducted in an atmosphere of uneasy confidence. Commodity prices remain firm, the feature of the past few weeks being the steady demand for tin.

Southern Africa.—In the new South African currency the total estimated profit of the gold mines which are members of the Transvaal and Orange Free State Chamber of Mines for the March quarter is given as R63,848,770, of which R3,182,991 is attributed to primary uranium producers.

Last month shareholders of WEST WITWATERSRAND AREAS were informed that the Ventersdorp Contact Reef had been intersected in a deflection of borehole No. 21 on Farm Rietfontein 349 at a depth of 8,490 ft., assaying 95·4 dwt. in gold per ton over a corrected width of 32·5 in.

In borehole HB 25, situated 9,700 ft. west-north-west of HARTEBEESTFONTEIN No. 2 shaft the Vaal Reef, it was stated last month, was cut at 7,678 ft., assaying 10·9 dwt. over 24·5 in. Two deflections gave values of 7·23 dwt. and 5·69 dwt.

At the annual meeting of WESTERN AREAS GOLD MINING held in Johannesburg earlier this month shareholders were informed that two of the cross-cuts being put out towards the Ventersdorp Contact Reef had reached the position of that Reef. Certain reef bands in the Elsburg horizon have been selected for development and a limited footage has been accomplished on these reef bands and on the Ventersdorp Contact Reef in preparation for a full-scale programme of rising. It is anticipated, it was stated, that the rate of development on reef east and west of this shaft pillar can now progressively be increased, in particular on the Elsburg horizon on which it is considered likely that several bands will be of economic interest.

Last month the South African Minister of Mines, Senator J. de Klerk, opened a new pilot plant for refining uranium at the Government metallurgical laboratories in Johannesburg. Costing R500,000 (£250,000) the plant is capable of refining 100 tons of uranium a year and is the first to be built in South Africa. It is to be used basically as a research project for the investigation of methods of refining uranium metals and salts. Nuclear fuels produced at the plant will be tested in the South African Atomic Energy Board's reactor, which is expected to be commissioned at Pelindaba towards the end of 1963.

The accounts of VAAL REEF EXPLORATION AND MINING for 1960 show a surplus of £4,621,763 and a total of £4,850,698 available, of which dividends equal to 3s. 6d. a share required £1,837,500. In the year 1,194,000 tons of ore was milled and 542,362 oz. of gold and 568,758 lb. of uranium oxide recovered.

At an extraordinary meeting of WESTERN DEEP LEVELS to be held later this month in Johannesburg it is to be proposed that the company's capital be increased to R46,000,000 by the creation of 4,400,000 " B " shares of R2 each. The No. 3 vertical shaft system has been commissioned and work on the opening up of the Ventersdorp Contact Reef from the No. 3 shaft has been in progress for some months, it is stated. Work is also in progress on the excavations for the headgear of the No. 3 sub-vertical main shaft. Full-scale sinking of this shaft is due to commence towards the end of the current year.

The report of EAST GEDULD MINES for 1960 shows that operations resulted in a profit of £1,512,042. The accounts show £2,145,988 available for appropriation, dividends equal to 3s. 5·6d. per stock unit requiring £1,560,000. The mill produced 456,719 oz. of gold in the year, from 1,564,000 tons of ore treated.

GROOTVLEI PROPRIETARY MINES reports a profit of £1,428,848 for 1960 and an available total of £2,119,418, of which £1,420,320 is required for dividends equal to 2s. 5·8d. per unit of stock. In the year 2,625,000 tons of ore was crushed and 545,228 oz. of gold recovered.

The operations of VLAKFONTEIN GOLD MINING for 1960 resulted in a profit of R2,597,907, dividends equalling 20⅛ cents requiring R1,210,000. The year's output totalled 222,349 oz. of gold from 617,000 tons of ore milled.

The accounts of VOGELSTRUISBULT GOLD MINING AREAS for 1960 show a profit of R1,728,551, an available total of R2,026,628, R1,167,904 transferred to capital reserve, and R627,238 against capital repayments. The plant crushed 1,020,000 tons of ore in the year

and recovered 218,736 oz. of gold, while 210,225 lb. of uranium oxide was also produced.

WEST RAND CONSOLIDATED reports a profit of £1,463,071 for 1960, the accounts showing £2,582,945 available, of which dividends require £1,477,637, equal to 4s. 3d. on the ordinary shares. In the year the gold mill treated 1,583,000 tons of ore and recovered 228,646 oz. of gold, while the uranium mill treated 911,000 tons and produced 640,170 lb. of uranium oxide and 21,995 oz. of gold.

The operations of VAAL REEF EXPLORATION AND DEVELOPMENT for 1960 resulted in a profit of £3,531,622. The accounts show £4,170,361 available, of which £875,000 is required for dividends equal to 2s. 6d. a share. In the year 1,663,500 tons of ore was treated and 471,515 oz. of gold produced, while the uranium plant recovered 655,994 lb. of uranium oxide.

In his review accompanying the report and accounts of CONSOLIDATED MURCHISON (TRANSVAAL) GOLDFIELDS AND DEVELOPMENT for 1960 the chairman says that production was of a similar order to that of the previous year, but the revenue increased from £925,346 to £1,027,425. Since the end of the financial year there have been further increases in the prices realized for cobbed ore and concentrates and the United Kingdom price for antimony regulus 99% has been further increased to £230 per long ton. In the year under review the mill was fed with ore derived mainly from the Gravelotte section, although during the latter half of the year this was augmented by tonnage mined at the United Jack and Mulati sections. It is the intention during the current and future years, the chairman says, to obtain an increasing tonnage of ore from sources other than the Gravelotte section in order to conserve to some extent the ore reserves at this section pending the completion of the exploration programme, which is being vigorously pursued. No new orebodies of any significance were discovered during the year, but the geological investigations carried out have indicated a number of possible areas which it is intended to test by trenching, diamond drilling, and underground development.

Elsewhere in this issue our Johannesburg correspondent refers to the negotiations being undertaken between the directors of WEST RAND CONSOLIDATED MINES and PALMIET CHROME for the establishment of a plant for the production of ferro-chrome and allied products at West Rand. It is planned to incorporate portions of the redundant south reduction works. West Rand Consolidated will acquire a 20% interest in the reorganized capital of Palmiet Chrome and participate in loan facilities for the establishment of the first plant unit.

In the three months to March 31 the MESSINA (TRANSVAAL) DEVELOPMENT COMPANY mined 260,556 tons of ore containing 3,951 tons of recoverable copper.

The report of the ROOIBERG MINERALS DEVELOPMENT COMPANY for the March quarter shows an estimated working profit of R35,958. In the period the two concentrators produced together 282 long tons of tin concentrates.

The accounts of WEST RAND INVESTMENT TRUST for 1960 show a profit of £2,340,432 and a total of £2,677,314 available. Dividends equal to 3s. 6d. a share require £1,832,827, while £550,000 has been placed to reserve, leaving £294,487 to be carried forward.

VEREENIGING ESTATES reports a profit of £1,405,521 for 1960 and an available total of £1,822,822. Dividends equal to 8s. 6d. a share require £1,168,750 of this amount.

Orange Free State.—The report of ST. HELENA GOLD MINES for 1960 shows a profit of £4,244,206 and a total of £5,243,468 available, of which dividends equal to 5s. a share require £2,406,250. In the year 2,004,000 tons of ore was milled and 684,966 oz. of gold recovered.

The accounts of the ORANGE FREE STATE INVESTMENT TRUST for 1960 show a profit of £3,129,439. With the sum brought in there was £3,469,651 available, of which dividends equal to 5s. a share require £2,735,852.

Diamonds.—In his statement for 1960 to shareholders of DE BEERS CONSOLIDATED MINES the chairman, Mr. H. F. Oppenheimer, says that sales of diamonds in 1960, at £89,700,000, were less by £1,435,000 than in 1959. The decrease was made up of a decrease of £1,853,000 in sales of industrials and of a small increase of £418,000 in the sale of gems. These results must be considered in relation to the fact that greatly increased quantities of diamonds produced by individual diggers in Sierra Leone and also a substantial quantity of diamonds mined in Russia were purchased during the year by the Diamond Corporation. The company, the chairman said, has made arrangements to start the manufacture of synthetic industrial diamonds on a commercial scale. The material produced is an abrasive diamond grit used in the manufacture of grinding wheels, similar to that

being marketed by the General Electric Company. The work is to be carried out by a subsidiary of Industrial Distributors called "ULTRA HIGH PRESSURE UNITS, LTD." While a factory has been designed on a substantial scale and will be capable, in case of need, of producing a very large caratage, it is intended so long as supplies of Congo boart are delivered in the normal manner to operate the new factory on a restricted basis only.

It was announced last month that the directors of PREMIER (TRANSVAAL) DIAMOND MINING have decided that an additional plant of a designed capacity of of 500,000 loads per month be erected at the mine. Besides raising the production of the mine the new plant will give great flexibility to operations from the point of view of the type of diamonds produced. This plant will cost between R3,000,000 (£1,500,000) and R4,000,000 (£2,000,000), it is stated, and, in addition, further capital expenditure estimated at R1,400,000 (£700,000) will be spent on opening up the mine at deeper levels. In view of the considerable capital expenditure involved the directors announced that the preference dividend would necessarily have to be passed until at least 1964, after which it should be possible to repay arrears at a faster rate than in the past.

The accounts of the CONSOLIDATED DIAMOND MINES OF SOUTH-WEST AFRICA for 1960 show a profit of £15,186,657 and £22,023,458 available. Of this amount £5,500,000 is required for preference dividends and £7,222,688 for ordinary dividends. In the year the company won 933,937 carats of diamonds, 3,663 in the course of prospecting operations. A total of 21,571 cu. m. of terrace gravels were recovered from 8,000 linear metres of trenching during prospecting and sampled, against 31,489 cu. m. from 13,205 linear metres of trenching in 1959. Apart from a limited amount of work to be done in the Northern Area, primary prospecting is virtually complete. After allowing for depletion, some 675,000 carats of diamonds were added to the estimated reserves during 1960.

Southern Rhodesia.—In the three months to March 31 last M.T.D. (MANGULA) milled 283,700 short tons of ore and recovered concentrates containing 3,239 tons of copper.

It nas been reported that preliminary talks have been held regarding the establishment of a Rhodesian aluminium smelting industry and that representatives of ALUMINIUM-INDUSTRIE-A.G., of Zurich, have made some investigations.

Northern Rhodesia.—The report of RHODESIA BROKEN HILL DEVELOPMENT for 1960 shows a profit of £932,958 and £1,283,289 available, of which dividends totalling 1s. 2·4d. a share require £487,500. In the year 14,429 long tons of lead, 29,794 tons of zinc, 57,957 lb. of cadmium, and 138,183 oz. of silver were produced.

In the March quarter MUFULIRA COPPER MINES produced 24,221 tons of copper for an estimated profit of £1,245,000, while CHIBULUMA MINES produced 4,805 tons at a profit of £234,000, both before taxation. In the same period ROAN ANTELOPE COPPER MINES produced 19,752 long tons of copper for a profit of £863,000.

Tanganyika.—In the three months to March 31 last GEITA GOLD MINING milled 64,230 tons of ore and produced 11,055 oz. of gold. There was an estimated working profit of £973.

Liberia.—It was announced from Monrovia earlier this month that iron-ore shipments in 1961 are likely to exceed those of rubber for the first time. Since 1951 the LIBERIAN MINING COMPANY has been the sole producer, but in July ore trains should begin to run from the Mano River concession of the NATIONAL IRON ORE CO., LTD., and within two to three years, this mine will be shipping 5,000,000 tons annually. Then, in 1963–64, two other mining developments are expected to come into production, one a £72,000,000 combine, the LAMCO JOINT VENTURE ENTERPRISE, formed to exploit a mile-high mountain of solid iron, Mt. Nimba. The other is DELIMCO (originally Deutsches-Liberische Minen) a £45,000,000 undertaking which is now constructing facilities in the Bong Hills.

Australia.—MARY KATHLEEN URANIUM reports that in the three months to March 31 last 110,000 tons of ore was milled and 403,000 lb. of uranium oxide produced. The profit for the period was £A543,417.

In the March quarter the MOUNT LYELL MINING AND RAILWAY COMPANY treated 471,029 tons of ore and produced concentrates containing 2,912 tons of recoverable copper. At the smelter 1,158 tons of blister copper was produced.

New Guinea.—In the nine months to February 28 BULOLO GOLD DREDGING treated 4,067,765 cu. yd. of ground and recovered 13,114 oz. of gold. The net profit from operations in New Guinea and Australia for the nine months is estimated at $220,000, after

providing \$70,200 for income tax and \$157,800 for depreciation. In addition, Bulolo has received dividends from COMMONWEALTH-NEW GUINEA TIMBERS, LTD., and PLACER DEVELOPMENT, LTD., totalling \$268,000, making a total estimated net profit of \$488,000 for the nine month period.

United States.—It has been announced that GOLD FIELDS MINING AND INDUSTRIAL, LTD., a wholly-owned subsidiary of the CONSOLIDATED GOLD FIELDS OF SOUTH AFRICA, LTD., and its wholly-owned American subsidiary, TRI-STATE ZINC INC. have entered into a Joint Venture Agreement with the AMERICAN ZINC, LEAD, AND SMELTING COMPANY, under which Tri-State will mine and mill zinc ore deposits owned by American Zinc near New Market, Tennessee. This agreement, it is stated, confirms an understanding reached last year, when Tri-State agreed to extend the drilling programme carried out by American Zinc between 1954 and 1957, and, on the successful completion of this programme, to develop the mine and erect a treatment plant. The further drilling carried out by Tri-State during the past year has confirmed the original estimates that the orebodies will provide at least 20,000,000 tons of ore from which high-grade zinc concentrates will be produced. It is anticipated that the mill will be completed to a capacity of 2,800 tons of ore per day during the summer of 1962 and this will ultimately be increased to 3,600 tons per day. It is planned to bring the mine to production at 2,400 tons per day by the summer of 1963 and, while the output of the mine is being expanded excess mill capacity will be utilized for milling ore from the nearby mines of American Zinc. The total cost of bringing the project to production on this basis, including the agreed capital value of the mineral deposits and rights contributed by American Zinc, is expected to amount to nearly \$6,000,000. Tri-State is to manage the Joint Venture.

Canada.—RIO ALGOM MINES reports a profit of \$3,066,000 for the March quarter. In the period 893,000 tons of ore was milled, production coming from three mines as compared to six mines which were producing during the same period in 1960. This is in accordance with the plan for stretching-out the present uranium contracts as agreed with ELDORADO MINING AND REFINING, LTD. Eldorado recently announced that there are letters of intent covering the sale of 12,000 tons of uranium concentrates by Canada to the United Kingdom. When current negotiations between the Canadian and United Kingdom Governments are concluded the company will doubtless be advised of its participation in this contract.

DIVIDENDS DECLARED

* Interim. † Final.

(Less Tax unless otherwise stated.)

***Broken Hill South.**—4d. Aust., payable June 24.

***Clutha River Gold Dredging.**—½d., payable May 10.

†**Consolidated Zinc Corporation.**—2s. 9d., payable July 1.

***Denison Mines.**—50 cents, payable May 15; 50 cents, payable Oct. 16.

†**Ex-Lands Nigeria.**—8·4d., payable June 6.

†**General Mining and Finance Corporation.**—Ord. 4s., payable June 30.

***General Tin Investments.**—6%, payable May 17.

Globe and Phoenix Gold Mining.—†2s. and *3s., payable May 25.

†**Gold Mines of Kalgoorlie (Aust.).**—6d. Aust., payable June 1.

†**Hongkong Tin.**—9d., payable May 24.

International Nickel Co. of Canada.—Quarterly, 40 cents, payable June 20.

†**Killinghall Tin.**—1s. 3d., payable May 24.

***Lampa Mining.**—7½%.

†**Loloma (Fiji) Gold Mines.**—1s. 3d. Aust., payable July 7.

***M.T.D. (Mangula).**—3d., payable June 26.

†**Mary Kathleen Uranium.**—2s. Aust., payable May 25.

***Messina (Transvaal) Development Co.**—9d., payable July 4.

***Mount Isa Mines.**—6d. Aust., payable June 30.

***Mufulira Copper Mines.**—2s., payable July 1.

†**New Broken Hill Consolidated.**—2s., payable July 1.

***North Broken Hill.**—5d. Aust., payable June 21.

†**Oceana Development Co.**—10%, payable July 13.

***Pahang Consolidated.**—6d., payable June 10.

Pengkalen.—*4½d. and †4½d., payable May 20.

***Rhodesian Selection Trust.**—4½d., payable July 1.

†**Rio Tinto Co.**—2s. 9d., payable June 2.

***Roan Antelope Copper Mines.**—4d., payable July 3.

***Sungei Besi Mines.**—1s., payable May 12.

***Tanjong Tin Dredging.**—1s., payable May 13.

†**Tharsis Sulphur and Copper.**—12½%.

METAL PRICES

May 9.

Aluminium, Antimony, and Nickel per long ton; Chromium per lb.; Platinum per standard oz.; Gold and Silver per fine oz.; Wolfram per unit.

	£	s.	d.
Aluminium (Home)	186	0	0
Antimony (Eng. 99%)	230	0	0
Chromium (98%–99%)		7	2
Nickel (Home)	600	0	0
Platinum (Refined)	30	5	0
Silver		6	7⅜
Gold	12	10	9½
Wolfram (U.K.)		—	
(World)	6	1	0
Tin, Copper, Lead, Zinc	See Table, p. 304		

The Congress in Africa

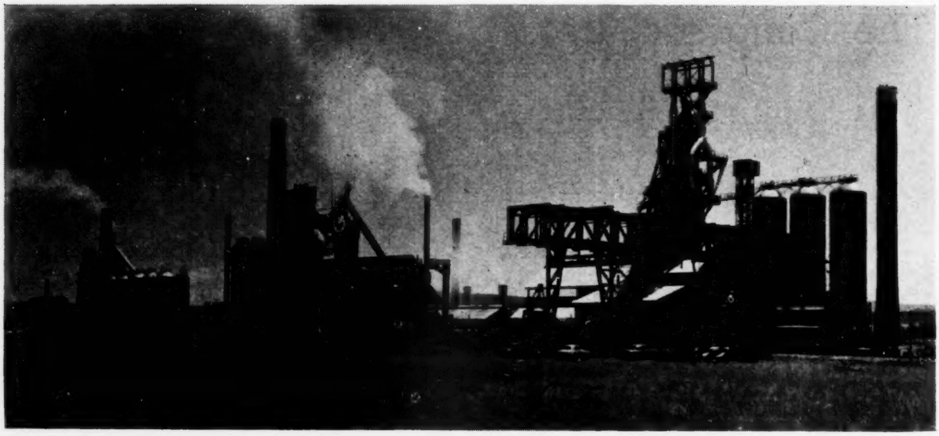
By Our Johannesburg Correspondent

Proceedings at the Seventh Commonwealth Mining and Metallurgical Congress in Johannesburg

On April 10, 1961, delegates to the Seventh Commonwealth Mining and Metallurgical Congress made a dismal way through swirling mist and dampening drizzles to register, and complete their various arrangements for tours and other matters, at the Johannesburg headquarters—the Cranbrooke Hotel, tucked away quietly below the crenellated ridge of the Berea and Hillbrow. According to choice, their tours would take them on the South African limb of the Congress to the gold and uranium mines of the undulating Southern Transvaal and of the flatlands—with isolated, bleak, and usually plateau crested hillocks or koppies—of the Orange Free State; to the mineral storehouse of the Bushveld Igneous Complex in the Central Transvaal, where eager eyes would feast on diamonds, the platinum-group metals, iron ore, antimony, asbestos, copper, chromite, phosphate, and vanadium, and beyond the limits of the Complex, to the Messina copper deposits—worked today, as in ancient times, on the southern banks of the Limpopo River to the north, and to the massive coalfields to the south of the Complex.

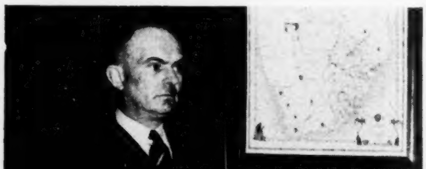
Some would elect to visit the workings of ilmenite sands at Umgababa on the coast south of Durban, washed by the pounding rollers of the warm Indian Ocean and to be the guests of the Natal Coal Owners' Society, whose eyes would be cast fretfully at the

Mr. W. A. Findlay Welcomes Delegates to the Union.



Amcor's Newcastle Iron Works.

meagre trade routes of the same seas. Some would pin their badges and hopes to the diamond pipes, to the massive iron and manganese, and to the blue asbestos mines of the arid Kimberley-Kuruman—Postmasburg-Koegas triangle of the Northern Cape; some would do the long haul to the diamondiferous marine terraces of the desolate Oranjemund and Alexander Bay coast and perhaps as well to the lead-copper-silver-germanium complex of Tsumeb to the north; or the long haul to the majestic panoramas, undimmed even by winter's chill, of the South-Western Cape, where the mother-city huddles broodingly against the slopes of Table Mountain. All would return visually enriched by expectations first excited in long anticipation and in the conference halls of Johannesburg, Welkom, and Kimberley, where the willing hands of the Congress staff stretched to the point of strain in help, and then realized in a feast of satisfaction.



Mr. C. B. Anderson: President, Transvaal and O.F.S. Chamber of Mines.

The heavy driven clouds (which held up some delegates, including the regional vice-president for Southern Rhodesia—the Hon. Sir George Davenport, who, diverted to terminal points other than Johannesburg, must have thought the tours had already begun) cleared for the inauguration ceremony on April 11 by the president, Mr. C. S. McLean. Departing from the precedent that the president should follow a scientific or technical approach on the reasonable grounds that a surfeit would be provided in the technical sessions, he directed the minds of the delegates to the very pertinent question—"Why are we all here?" Three very good, interrelated answers were given: The delegates were gathered in the fold of the Congress from different parts of the world and of South Africa to see for themselves and discuss something very close to their hearts and pockets—mining and its allied sciences, the interest of travel in other countries, to meet other people, to see how they lived, to hear what they say, to learn what they think. "In Southern Africa," Mr. McLean commented, "you will meet a people who are notably hospitable and friendly in the three countries in which the Congress is being held, each in so many ways resembling the others and yet quite dissimilar; contiguous and yet

A Group of Canadian Delegates.

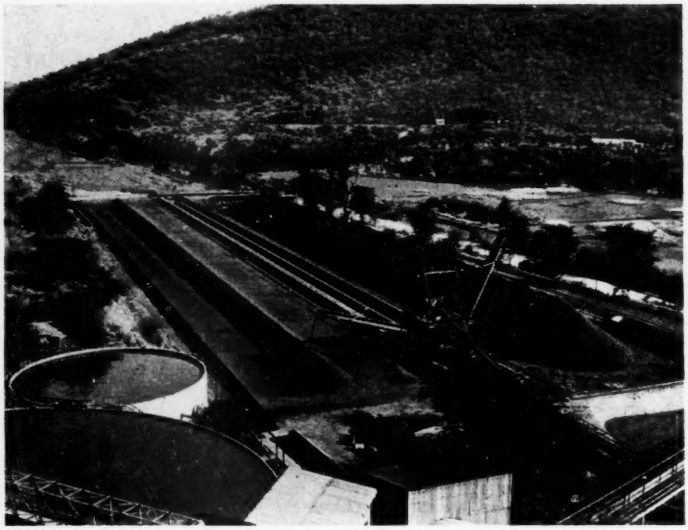
poles apart . . . each of them rich in minerals . . . each of them with a multi-racial society, (in which) . . . you will see and hear how the problems of a multi-racial society are being tackled from different angles . . ., (in which), if the solution were simple—other than in theory—there would be no problem ; it would have been solved long ago. . . . Here Nature has hidden its treasure of inestimable mineral wealth," and here will be seen " how . . . the sciences, far from lagging, are keeping pace with the world at large " and how the mining industry, as virtually everywhere, has been to the forefront of the development of industry.

The last Congress held in Johannesburg was more than 30 years ago. Then, a single, pot-holed, corrugated, and sandy road ran its some 60 nerve-wracking miles from Nigel to Randfontein—the existing extent of the Witwatersrand gold-mining industry. Today the golden arc curves for nearly 300 miles—from Kinross in the Eastern Transvaal to the Sand River in the Free State. That third Congress was also held just before regular air services were introduced to link the high-veld interior with the coastal belt. In the 30 intervening years milling has risen from 31,000,000 to 71,000,000 tons a year, the gold output from 10,400,000 to 20,900,000 oz., and the value of the output from £44,000,000 to £262,000,000. In the same period the value of metallic ore production has climbed from a mere £800,000 to £71,000,000 and of the non-metallic output from £4,000,000 to £39,000,000. Gold-mining stores were then derived as to 35% from imports ; in 1960 91% were of South African origin.

Over the broad sweep of the 30 years, the president believed, the gold-mining industry's greatest achievements were to be found in the ultra-deep levels—in the deepening of workings from 7,200 ft. to 11,246 ft. " The future, no less than the past," he added, " is dependent on mines and mining men. . . . Historically, mining has been the lifeblood of advancing civilization and it will continue to be so." The president paid tribute to the executive committees, the many working sub-committees, and to the large number of voluntary workers, both in the Union of South Africa and in the Rhodesias, enthusiastically generous of their time and service. A tribute was also paid to the late Michael Falcon, chairman of the executive committee, who died on the very eve of the Congress, which he had painstakingly moulded over a period of more than three years, the Congress programme states, and adds that his way was gentle and unobtrusive but his guiding hand firm and resolute.

Warm greetings were extended to the delegates by Mr. W. S. Findlay, South African vice-president, and by Sir Ronald Prain, O.B.E., in anticipation of their visit to Northern Rhodesia, for which he was regional vice-president, over the week to May 14, and by Sir Ronald on behalf of the unavoidably absent the Hon. Sir George Davenport, K.B.E., C.M.G., regional vice-president for Southern Rhodesia, in anticipation of the visit to Southern Rhodesia, over

The Hon. Sir George Davenport, with Brig. R. S. G. Stokes.



Ore-Bedding Plant at Thabazimbi.

the final week of the Congress. Greetings were received from the constituent organizations of the Commonwealth Council of Mining and Metallurgical Institutions, such as the Australasian Institute of Mining and Metallurgy, the Canadian Institute of Mining and Metallurgy, the Geological Society of South Africa, the Institute of Metals, the Institute of Petroleum, the Institution of Metallurgists, the Institution of Mining Engineers, the Institution of Mining and Metallurgy, the Canadian Metal and Mining Association, the Iron and Steel Institute, the Mining, Geological and Metallurgical Institute of India, the South African Institute of Mining and Metallurgy, the South Wales Institute of Engineers, and (by special invitation) the Mining and Metallurgical Society of America.

Members from Australia.

The programme of the Seventh Congress acknowledges the exceedingly generous financial assistance given it by the Union Government, the Transvaal and Orange Free State Chamber of Mines, De Beers Consolidated Mines, Ltd., the Collieries Committee of the Chamber of Mines, African Explosives and Chemical Industries, Ltd., the Natal Coal Owners' Society, S.A. Cyanamid (Pty.), Ltd., and the ready support given by people and companies—too many for individual mention, and particularly the major " groups "—Anglo American, Anglo-Transvaal, General Mining, Gold Fields, Johannesburg Consolidated, Rand Mines, and Union Corporation, and their associated companies.

The formal inauguration of the Congress was followed by the reading of the four introductory papers. Mr. C. B. Anderson—president of the Transvaal and Orange Free State Chamber of Mines—dealt with the organization and management of the gold-mining industry in South Africa. " Rhodes and Rudd formed The Gold Fields of South Africa, Ltd., in 1887," he explained, regarding the development of the " group " system, " . . . and others were not long in following—Wernher, Beit and Co. ; Barnato and the Joels and the Johannesburg Consolidated Investment Co., Ltd., the Eckstein-Rand Mines group, and A. Goerz and Co., later the Union Corporation, Ltd. These and other

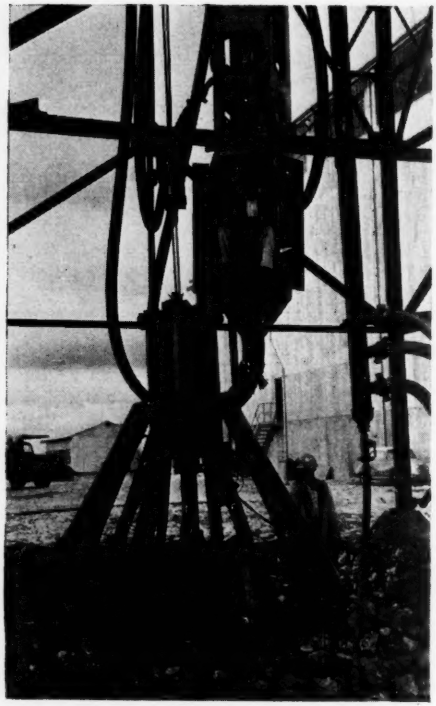
Group at a R.S.M. Past-Students Supper.

'groups' formed later earned the confidence of the investing public. . . . Thus at the end of the first decade . . ., the general organization of the industry had taken, as a result of the concentration of control of individual mines in the hands of a few financial 'groups,' the form which it bears to the present day, when all but two of the 66 gold and uranium mining members of the Chamber of Mines are administered by one or other of seven major mining finance houses." Mainly low grade, the gold mines can remain profitable only by paying the closest attention to costs and exercising the most rigorous economies. The "group" organization undoubtedly facilitates this and the keeping of costs down below the virtually fixed price of gold.

It is customary for each mining company to operate only one mine (that in the course of its life generally sinks many shafts), the chief asset of such a company being its legal title to its mining property. In South African law the right to mine precious metals is vested in the State, although the ownership of the metals is vested in the holder of the mineral rights over the land in which the metals lie. Hence the State leases the right to mine the precious metal. At the present time a new gold-mining title is usually a lease from the Government, in terms of which the company pays to the State a share of the profits from working the lease, in addition to paying the taxation levied on the profits by Statute. Both the lease and tax payments, based on sliding-scale formulae related to the ratio of profit to revenue, can amount to as much as two-thirds of the profits, when all capital expenditure has been redeemed.

There is nothing unusual in the organization of an individual producing mine, which follows the normal mining (or in the words of some—army) pattern as existing in most parts of the world and of South Africa. However, it is often alleged that the mines do not make the best and most economic use

The Hon. B. J. Schoeman, Minister of Transport, with other Union Officials.



Cactus-Grab Assembly, Hartebeestfontein.

of native labour, but in terms of the Mines and Works Act only " scheduled " persons may handle or be in charge of explosives and may be granted Government Certificates of Competency. The Act defines " scheduled " persons as Europeans, Cape Coloureds, and persons from Mauritius or St. Helena, and their descendants born in the Union. Miners who blast, onsetters, banksmen, locomotive drivers transporting persons, winding-engine drivers, lampmen, and boiler attendants must hold Certificates of Competency. The native labour force underground cannot therefore be employed in any responsible positions, must always be supervised by " scheduled " persons, is and remains predominantly unskilled. By law every mine must provide free hospital services for its native labourers, who are housed and fed free in the single quarters of the compounds.

Under the Act referred to the general manager is responsible for the day-to-day running of his mine, but on the broader issues of operating policy is guided by a consulting engineer in the controlling group, while remaining responsible to the company's board of directors. In turn the consulting engineer is in very close contact with the board's chairman. While the board is by custom largely composed of nominees of the controlling " group," it is responsible to the company's owners, the shareholders (who usually include, but not necessarily so, the parent company of the group, which company need not hold directly or effectively a majority shareholding). The position of the directors themselves depends ultimately on the continued support and confidence of those shareholders who have elected them (or who, as has been stated at times, are sufficiently or effectively organized to elect them). In most cases, Mr. Anderson stated, the individual shareholders could bring about a change of management, but this would obviously involve an organized movement and/or the invoking of at least a measure of public opinion, which may be a costly and difficult process. Satisfied shareholders would doubtless be loath to participate in such a movement, especially in times when pressures are not always motivated from the best of grounds.

In a general system that can affect share-market values, sometimes violently, complaints are bound to be heard occasionally that the smaller shareholders' interests are apt to be neglected or ignored or even overridden ; or that immediate access to vital information is confined more to the major or potentially or actually more important than to the minor or less important or more scattered/less organized shareholders, or that the broking agencies are more quickly or better informed than the controlling houses. While these complaints may be justified more in belief than in fact or essence, they do exist and are reflected in the development of associations for the protection of shareholders' interests. It is difficult to envisage that these associations will develop into controlling houses themselves or that their objectives include the placing of management in strait-jackets. For all practical purposes the frying-pan is as hot as the fire. For no other reason, therefore, one can expect shareholders to continue their recognition and support of a system that places control and administration of their mines in the hands of one or other of the major mining houses. These have, as stated by Mr. Anderson, strong financial resources, efficient and experienced technical and administrative staff, and long and intimate

A Group of Delegates in Discussion.

experience of mining. After all, there is this difference between the civil service of the State and what is said to be the civil service of the gold-mining industry—one sooner or later has to pay one's taxes ; one does not have to buy shares.

It may be asked what the " group " benefits cost an associated company. Figures taken out by the Chamber for 1959 show that, on average over the industry as a whole, " group " or head-office charges (including the London office) amounted to 9·2d. per ton milled or only 1·6% of average working costs for that year. (Average working costs for gold-mine members of the Chamber were 45·33s. in 1959 and 46·5s. per ton milled in 1960.) Other benefits ? Mr. Anderson cited exploration in both the technical and financial references. He very much doubted whether the enormous development in the post-war years involving capital expenditures of £470,000,000—mostly in the Orange Free State, Far West Rand, Klerksdorp, and Kinross fields—would have been possible under any other form of administration. Any other benefits ? The spread of " group " interests embraces not only gold but also diamonds, coal, platinum, base metals and minerals, explosives, fertilizers, paper and cement manufacturing, food products, the development of forestry, and a host of other activities. Furthermore, the " groups " have undoubtedly furthered the country's secondary industry development and have played a large part in establishing a short-term money market. In brief, the " group " provides technical services, acts as managers —secretaries—accountants, and not least of all provides a centralized buying department with all its attendant economies. (Official statements have indicated continued support for the " group " system.)

Complementary to and intimately interwoven with the group system is the organization of the Transvaal and Orange Free State Chamber of Mines—an association of gold, coal, and uranium mining and associated financial companies, that as far as possible formulates policy on matters common to the mining industry. It provides the following services :—

The negotiation of industry-wide agreements (including minimum wage rates and conditions of employment) on labour matters and the supply of certain materials.

The recruiting and distribution among its members of the native labour (mainly from the Union, the British High Commissioner Territories (Protectorates), Mocambique, Nyasaland, Tanganyika, (etc.) and providing for the welfare of this labour.

Conducting research and training schemes.

Advancing the ideals of industrial safety.

Refining gold and calcining uranium oxide for shipment.

Extracting and marketing by-products of gold mining.

Providing secretarial, legal, and other specialized services, including social welfare.

Maintaining a public relations department to develop public knowledge and understanding of the gold, coal, and uranium mining industries.

Acting as the mouthpiece of the mining industry in dealing with the Government on matters affecting the industry as a whole and in general giving expression to the spirit of co-operation that characterizes the gold, coal, and uranium mining industries.

It has sometimes been alleged that through

the Chamber the mining industry imposes a restraint on the general economy and financial structure of the country. Such an allegation would require a detailed examination. However, it can be said that arising from the very nature of the association between the Government (in which is vested the right of mining scheduled metals) and the mining industry (which has established means of exploitation and is in a good position to acquire mineral rights), the application for and granting of mining leases would be subjected to very careful consideration ; that preference usually would naturally be given to indigenous companies ; that there would be assurances for such companies to be adequately capitalized and administered with due regard to the interests of all concerned.

On the general operational side in its broadest aspects the association could be reflected in maintaining such conditions as would restrain undue inflationary pressures in the whole economy (after all, gold is money) arising from the wage/salary trends and the costs of supplies and services over the whole range of power, transport, water, agricultural products, and equipment, etc. A satisfactory balance in the availability of the necessary categories of labour among the various industrial sectors must obviously be maintained. Conditions in the financial sector or money markets must be conducive to the needs of industry, from which the mining sector cannot be excluded, and this obviously involves intimate gearing of the whole sensitive financial system—the central and commercial banks, various institutions accepting public savings deposits, and the stock exchange, even possibly the legal profession. If holistic concepts are applied. perhaps upheld, it would appear to be more desirable that they be a summation rather than an integration ; that the individual interest be not submerged under a mass of collectivistic public weal, in which anybody's business is everybody's and therefore nobody's. Policies, whatever their source, that disrupt the smooth meshing of the gearing and tend to change the ratios must immediately be the concern of the associates concerned. Public investing confidence must be carefully, even jealously, safeguarded and nurtured, and on balance must be positive. Any major contention or conflict in policies would inevitably impose strain on the gearing of the whole system. Such appears to be the national importance of the industry, that by its nature and extent both primes and restrains the economy as a whole.

Notwithstanding the broad aspects of its organization and the nature of its major product (gold), Mr. Anderson emphasized that not all competitive spirit had been lost in the mining industry. Among the individual mines there is friendly rivalry and keen competition in certain sectors ; between the " groups " there is tremendous competition to discover and bring into being new mining ventures. The groups and their associated companies present different corporate images, the general and particular features of which are claimed to reflect manifold advantages under prevailing circumstances.

Mr. Anderson then passed the baton to Dr. W. J. Busschau, an executive committee member of the Chamber and chairman of Gold Fields of South Africa, Ltd., who reviewed the economy of the Union. Dr. Busschau commented that it is well to remember that the growth of particular industries is dependent on the progress of other industries and that economic growth does best proceed if the basic primary industries are themselves in a state of growth. In travelling around the mines, he said, delegates would find much growth still in progress and many projects in mining and in other spheres holding economic promise and awaiting development. Some of this is held up through the disturbances in the capital and other markets occasioned by non-economic factors, such as the consequences of disturbances in the Union and elsewhere in Africa. He expressed the view that the economy is growing with much potentiality of further growth . . . and that future opportunities are so great that the hindrances will in due course be swept away in another grand advance.

The opening addresses were concluded by Professor S. P. Jackson with an introduction to the physical geography and by Professor T. W. Gevers with an outline of the geology of Southern Africa. All the introductory addresses lowered a broad canvas as the backdrop to the changing scenes of the mining industry's many roles.

It was a more thoughtful throng that pressed through the draughts of the gallery and around the refreshment tables. A little doubt mingled with persuasion in the whispered comment carried on the air. " You know," it said, " this could still be the Promised Land."

(To be continued)

Tunnelling Operation in the Alps

Karl-Werner Bretz [1]

The author describes work on a power tunnel and the use of special equipment.

Introduction

In order to utilize the water power of the River Diveria (south of the Simplon tunnel) a pressure tunnel of approximately 22,000 ft. in length and a cross-section of 14·6 sq. yd. has been driven between Varzo and Crevola d'Ossola. Rock conditions are good, the rock being a granite gneiss with a specific weight of 169 lb. per cu. ft. solid.

The contract of the lower part of the tunnel—*i.e.*, from the reservoir to the outlet, extends over a total of 12,500 ft. From an opening drive the tunnel branches into three headings in which the same drilling and loading equipment are used. However, for the first time the normal stone trains hauling cars of 78 cu. ft. capacity have been replaced in one of the headings by a Salzgitter Bunkertrain (Type BZ 35). The design and working principle of this train have already

[1] Consulting engineer.

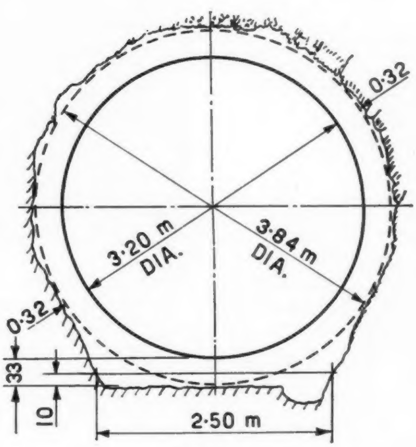


Fig. 2.

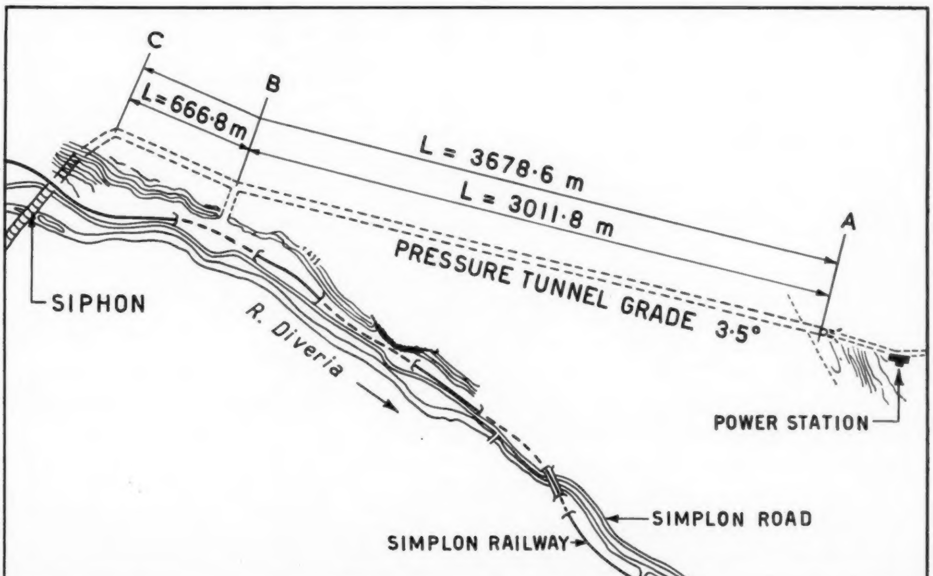


Fig. 1.—Situation of the Tunnel.

Table 1.

Working Times for Section A–B

I 600–1400	1 600–1800	II 1400–2200	2 1800–600	III 2200–600	Lunch time = 60 min.
–	1	–	1	–	Foreman
8	–	8	–	8	Drillers
–	1	–	1	–	Loaders
–	1	–	1	–	Driver of bunkertrain
–	1	–	1	–	Driver of locomotive
–	1	1	–	–	Assistant drillers
–	–	–	–	1	Worker
–	1	–	–	–	Plumber
–	2	–	–	–	Track worker
–	1	–	1	–	Blast foreman
–	2	–	2	–	Workers at unloading station
–	2	–	2	–	Workshop
Total 48					

Table 2.

Month.	*No. of working days.*	*No. of shifts.*	*No. of pulls.*	*Tunnelling advance.*	*Ft.*	*Per shift. ft. in.*	*Per shift. Pull.*	*Per pull. ft. in.*
Section A–B (Inclination 3 : 1,000)				530				
July	26	78	217	1,460 =	930	11 11	2·79	4 3
Aug.	22	60	138	2,100 =	640	10 8	2·30	4 8
Sept.	26	74	168	2,920 =	820	11 1	2·27	4 10
Oct.	27	79	194	3,850 =	930	11 10	2·46	4 9
Nov.	23	68	170	4,600 =	750	11 0	2·50	4 5
Dec.	11	31	71	4,930 =	330	10 8	2·29	4 8
Total	136	390	958		4,400			
Average . . .						11 4	2·46	4 7⅛
Section B–A (Declination 3 : 1,000)				33				
July	27	62	113	488 =	455	7 4	1·82	4 0
Aug.	22	63	115	955 =	467	7 5	1·83	4 1
Sept.	26	75	125	1,480 =	525	7 0	1·67	4 3
Oct.	26	72	117	1,940 =	460	6 5	1·63	3 11
Nov.	9*	24	33	2,060 =	120	5 0	1·38	3 8
Dec.								
* Heading closed due to illness.								
Total	110	296	503		2,027			
Average . . .						6 10	1·70	4 0
Section B–C (*Inclination* 3 : 1,000)				33				
July	27	62	88	417 =	384	6 2	1·42	4 4
Aug.	17	48	49	611 =	194	4 0	1·02	3 11
Sept.	25	49	85	914 =	303	6 2	1·73	3 7
Oct.	26	72	112	1,392 =	478	6 8	1·56	4 3
Nov.	24	69	123	1,910 =	518	7 6	1·78	4 3
Dec.	7	19	38	2,083 =	173	9 1	2·00	4 7
Total	126	319	495		2,050			
Average . . .						6 5	1·55	4 1½

Taking the highest advance achieved during the seven days in December in the heading B–C with 100% as a basis for comparison, the following results are obtained :—

Table 3.

Section.	*Pulls per shift*	*Ft. in. per shift.*	*Ft. in. per pull.*
B–C	2·00 = 100%	9 1½ = 100%	4 7 = 100%
A–B	2·46 = 123%	11 3½ = 124%	4 7 = 101%
B–A	1·70 = 85%	6 10 = 75%	4 0½ = 88%
B–C	1·55 = 77%	6 5 = 70%	4 1½ = 90%

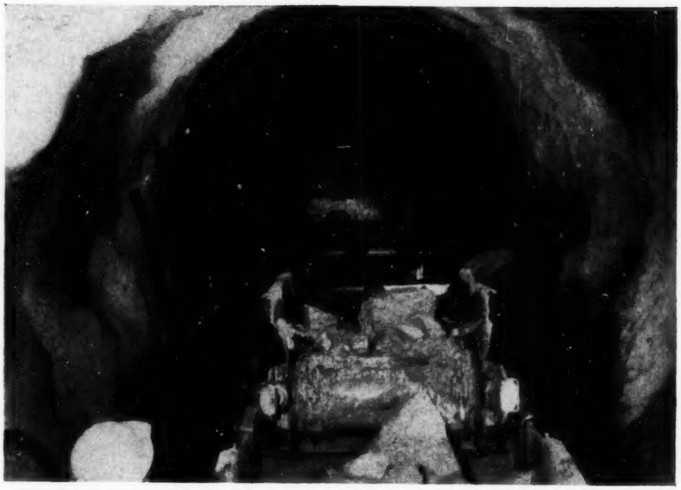


Fig. 3.—Loading at the Face.

been described (1), (2).[1] The deployment of manpower and the working cycle are the same in all three headings.

Working System, Section A–B (Fig. 1)

Drilling.—BBS 50 Tiger airleg drills are used with a theoretical drilling speed of approximately 22 in. per min. For one shothole of 6 ft. in length the total theoretical time for drilling and for secondary work is 4·5 min. The average practical speed, however, is only 15 in./min. and the overall time for one shothole of 5½ ft. is 5·6 min.

Blasting.—Blasting is still done pyrotechnically and the 4 to 6 holes of the central pattern are fired together with a detonator firing tape. The explosive generally used is G.D. 1° MT having a 38% content of nitroglycerine. It is supplied in cartridges of 1 in. by 7 in., the average consumption being approximately 4·3 lb/cu. yd. solid. No stemming is done and therefore the efficiency is low (4 ft. 8 in. : 5 ft. 6 in. = 0·82).

Ventilation.—Up to 3,300 ft. of driving, exhausting is done for approximately 10 min. after blasting, the remaining time being ventilation by blowing; over 3,300 ft. blowing only is used. The duct diameter is 16 in. The delay between the firing of the cut holes and the ground holes is 3 to 5 min.

[1] Figures in parentheses refer to references given at the end of the article. The Bunkertrain was also illustrated and described in the MAGAZINE for Oct., 1958, p. 253.

The low efficiency of the fan used—in spite of its motor power of 100 h.p. at 950 r.p.m., was immediately obvious because there was a 25 min. delay before the team could return to the face.

Loading.—The theoretical volume of one pull 15 sq. yd. by 1·7 yd. = 26·2 cu. yd. (solid) and the quantity of debris 46 cu. yd. The required capacity of the bunkertrain BZ 35 is thus 22 car sections. The loading machine used is a standard Salzgitter loader HL 400 with a bucket capacity of ½ cu. yd.

In spite of a high percentage of large rock pieces the average loading times achieved by the bunkertrain have been very good. The average quantity of muck from each blast was 46¼ cu. yd., which corresponds to a bunkertrain load of 40 cu. yd., allowing for the packing effect of the built-in pusher.

The average bucket load of the loader over 92 loading cycles was 13 cu. ft., which is equal to 1·88 cu. yd. per min. loading capacity. In the case of medium-sized rock pieces this capacity was increased to an average of 2·30 cu. yd. and 2·62 cu. yd. respectively. However, within the first 2,500 ft. of advance the inadequacy of the compressed-air plant became obvious and this resulted in delays in the loading period. During loading the tracks are provisionally extended by means of extension pieces of 3⅓, 6⅔, and 10 ft., which later on are replaced by a standard track section of 20 ft. long.

Checking and cleaning of the rock face is particularly important, especially in broken ground. After an initial minor accident had

Table 4

Comparison of Time on One Cycle

Theor. Min.	Theor. %		Operation.	Actual. Min.	Actual. %
15	9·4	(1)	Setting for drilling	15	7·7
40	25·0	(2)	Drilling with 6 airleg drills :		
			(*a*) 9 holes 6 ft. at 4·5 min. .		
			(*b*) 8 holes 5 ft. 6 ins. at 5·6 min. .	45	23·0
20	12·5	(3)	Charging and blasting . . .	20	10·2
15	9·4	(4)	Ventilation	30	15·4
5	3·1	(5)	Setting for loading	5	2·6
40	25·0	(6)	Loading with HL 400 into BZ 35 :		
			(*a*) 120 buckets at 20 sec. each		
			(*b*) 92 buckets at 16·3 sec. each	35	18·0
4	2·5	(7)	Track extension	5	2·6
6	3·7	(8)	Permanent tracks 20 ft. . . .	8	4·1
2	1·3	(9)	Clean face	8	4·1
5	3·1	(10)	Removal of loaders, etc. . .	8	4·1
8	5·0	(11)	Reserve	16	8·2
160	100·0		Total	195	100·0

Possible.	*Results.*	*Actual.*
3	Pulls per 8-hour shift . . .	2·46
9	Pulls per 24 hours	7·38
5 ft. 3 ins.	Average length of pull . . .	4 ft. 7 ins.
47 ft. 3 ins.	Advance in 24 hours . . .	34 ft.
1,181 ft.	Advance during 25 working days .	850 ft.

occurred, this is now done. The accumulator locomotive, with a capacity of 16,800 lb. at 25 h.p., is not powerful enough to move the loaded bunkertrain by itself. The loading machine therefore assists to get the bunkertrain moving.

Eight drillers are required for six airleg drills and one miner for the removal of drill rods during drilling ; two assistant miners carry out auxiliary work. The teams in the other two headings are similar but there the driver of the bunkertrain assists with the stone car trains.

Output per hour per cu. yd. rock in place :

(*a*) Tunnelling only :

25 men for 8 hours = 200 hours

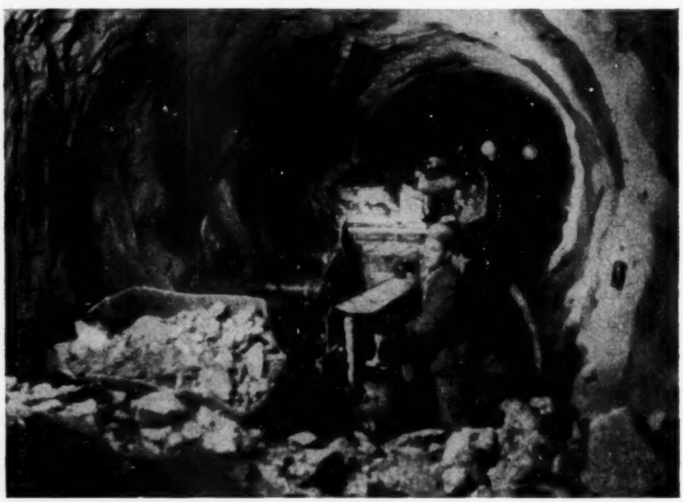
9 men for 11 hours = 99 hours

= 299 hours per working day

34 ft. per day × 132 sq. ft = 167 cu. yd. rock in place per day.

299 : 167 = 1·79 hours per cu. yd. rock in place.

Fig. 4.—Transferring Spoil to Bunkertrain Belt.



(*b*) Total per heading :
26 men for 8 hours = 208 hours
22 men for 11 hours = 242 hours
= 450 hours per working day.

450 : 167 = 2·70 hours per cu. yd. rock in place.

Any saving of labour by alternative systems of working cannot be discussed in this article.

Actual Tunnelling Advance per Month.

The figures given in this article were obtained during the period from July 2 until December 15, 1958, when the bunkertrain was in use. All figures in the tables are an average of the above period. Working time : 3 shifts for 8 hours per day.

From Table 2 it is evident that the advance in section A–B, using the bunkertrain, is very much higher than in the remaining sections.

Analysis of Progress (Section A-B)

Owing to his daily time studies the author is in a position to compare the planned working cycle with the actual results achieved (Table 4).

During the period under review ($5\frac{1}{2}$ months) only 72% of the theoretically possible advance and 82% of the cycles were achieved. These figures represent the efficiency of the contractor's work.

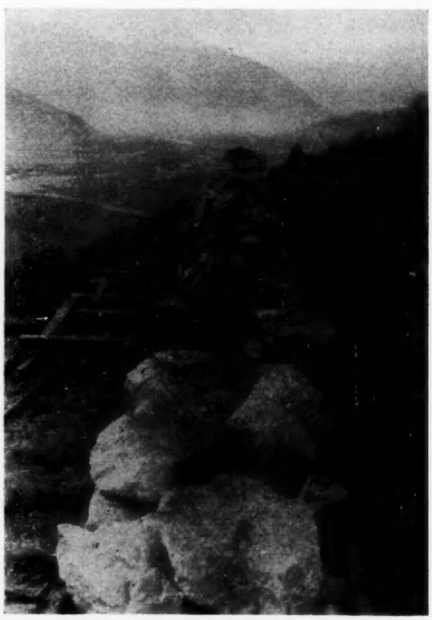


Fig. 5.—Loaded Bunkertrain.

Fig. 6.—Bunkertrain Unloaded.

Investigation into Delays and Suggestions for Elimination :

(1) *Ventilation* :

Reason : As already mentioned.

Advice : Adjustment of h.p. in relation to r.p.m. of the only available radial fan, which is installed at the tunnel mouth, corresponding with the requirements in the heading. Alternatively, use axial instead of radial fans, which would result in better ventilation conditions even at a lower power consumption. For instance, a two-step electric fan of 15 kW will bring 9·5 cu. ft. per min. of fresh air to a heading 3,000 ft. away from the tunnel mouth and the same amount with two of these fans up to 6,000 ft. away.

(2) *Length of Pull* :

Advice : (*a*) Adopt centre pattern to rock formation. (*b*) If required increase number of shot holes. (*c*) Improve on quality of explosives, at least for centre pattern (66% nitroglycerine). (*d*) Stemming of all shotholes

(best with stemming turbine) (5). (*e*) Electric shot firing.

For comparison average results of a tunnelling contract near Tessino can be quoted (4) :

Heading 18·4 cu. yd., rock "Tessino Gneiss," length of pull 5 ft. 1 in. with 56 shotholes having a depth of 5 ft. 9 in.–6 ft. = 10 ft. drilling per solid cu. yd.

Blasting scheme: Angle bore, centre cut with dynamite F (65% nitroglycerine), consumption of explosives 3·9 lb per cu. yd. rock in place, ignition miliseconds 0–10.

Time required.	*Tessino.*	*Crevola.*
Charging, stemming	18 min.	20 min.
Connecting, checking		
Ignition	5 min.	
Ventilation	5 min.	30 min.
	28 min.	50 min.

Thus approximately 22 min. could be saved and, furthermore, the average pull could be increased by about 10% to 5ft. 1 in. This could be achieved with the same quantity of explosives per blast, thereby reducing the consumption of explosives by 10% (total 3·9 lb. per cu. yd. rock in place). It should be possible to achieve the better results without increasing the number of shotholes.

(3) *Reserve* :

There were 8 min. provided in the Crevola scheme for interruptions, all delays occurring during the various operations and being in relation to them are included in the figures of the actual time of operation.

However, under 11 actual observations the following losses of time occurred : (*a*) Loss at change of shift team having taken place at mouth of tunnel instead of in heading, 12 min. ; (*b*) loss due to power and water failure, 2 min. ; (*c*) loss due to water seepage in heading, 2 min., a total average during an actual cycle of 16 min.

Fig. 7.—Loaded Bunkertrain at Tunnel Portal.

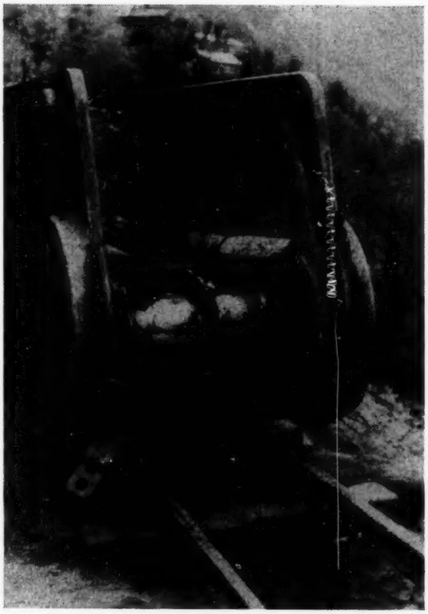


Fig. 8.—Train Discharge.

Advice: (*a*) It is essential that the teams change over in the heading; compensate team for extra time; thus the number of pulls per day could be increased from 7·38 to 7·88—*i.e.*, by about 7%. (*b*) The losses have to be tolerated, since it is rather uneconomical to provide any remedy. (*c*) By means of protective cloth this loss can be eliminated.

Interruptions while Using Bunkertrain

The average loading time of the bunkertrain has been indicated in Table 4 under 6b with 92 bucket cycles of the HL 400 at 16·3 sec. each = 35 min. This loading time provides for 7 min. of interruptions and a further 3 min. delay. The actual interruptions observed have been as follows:—

(*a*) Faulty operation: 7%. This generally occurs with new and inexperienced operators and will minimize with growing experience.

(*b*) Lack of maintenance and servicing: 23%. If operation instructions are carefully observed and work properly supervised, this loss should be completely eliminated.

(*c*) Untested design: 31%. On this job the bunkertrain had been subjected to maximum strains and reasons for breakdown of components have been eliminated; thus new bunkertrains are adapted avoiding any future losses.

(*d*) Breakdowns: 15%. Due to the use of a double chain scraper conveyor and a maximum number of car units, they are liable to occur. Since November 1, however, the treble chain scraper conveyor had been under trial and therefore no breakdowns occurred until the end of observation time.

(*e*) Breakdowns: 24%. Their reasons are badly-laid tracks and bends of too small a radius. This could be completely avoided at any future project. Nevertheless one should always provide for 5 min. "Breakdowns" per cycle in the planned schedule.

The delay of 3 min. originated from insufficient supplies of compressed air during loading. The delay in November amounted to about 15 min. per loading of train.

It should be possible to achieve the planned schedule provided the work is properly prepared and organized. If appropriate "advance-bonuses" are paid to the team this time schedule could be reduced by 10–20%. It should not be overlooked that on this project the bunkertrain has been used and time-checked from the very beginning—*i.e.*, without training of the tunnelling team. The results of the first months of use were 93% of theoretical cycles and 76% of theoretical advance.

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International Construction Equipment Exhibition

Many firms well-known as manufacturers of earth-moving machinery, as well as makers of mining machinery, are taking part in the first International Construction Equipment Exhibition which is to be held at the Crystal Palace site at Sydenham from June 15 to 24. A particularly interesting feature of the plans being made is that there will be two proving grounds where the machines can be studied in operation with adequate terrace and bridge viewing points. It is understood that considerable interest in the project has been aroused and that many overseas visitors are expected.

The Identification of Pollucite

Aids to work in the field and laboratory are described

K. F. G. Hosking, M.Sc., Ph.D., M.I.M.M.

Abstract

The economic importance of caesium is increasing rapidly and hence pollucite—the only mineral in which the element occurs as a major constituent—is certain to be sought for much more diligently than in the past.

As the mineral is generally not readily recognized amongst the other pegmatite minerals with which it is normally associated simple field and laboratory tests have been devised to facilitate its identification and these are described in the text.

Introduction

Recently the economic importance of caesium—the most reactive of all the elements—has been increasing in a most spectacular way and it was reported in the *Northern Miner* for March 3, 1960, " that experts foresee a more promising future for caesium than was the case for uranium about 12 years ago." Despite the high cost of the element (*c.* \$4.00 per gram.) and its compounds comparatively large quantities of these are now being used for experimental purposes and already the results of these experiments have been quite spectacular. Thus, within the past two years, a caesium plasma thermocouple has been developed for the direct conversion of heat to electricity and also two photomultiplier tubes have been designed which employ caesium telluride and caesium-antimony, respectively. The element is also regarded as a potentially important catalyst in the manufacture of certain fuels for guided missiles and the isotope Cs-137 is tending to take the place of Co-60 in the treatment of cancer.

This list by no means exhausts all the real and potential uses of the element.

Caesium, like rubidium and potassium, tends to become concentrated in the granitic (and to some extent the syenitic) fractions of magmas. It is, therefore, not surprising that potash feldspars and certain micas—particularly of granite pegmatites—may contain up to a few per cent. of caesia (Cs_2O) and that some of the other pegmatite minerals—notably, lepidolite and the beryls vorobyevite and rosterite—may do likewise. Even the adularia of late hydrothermal veins may hold significant amounts of the element. In addition, largely because the ionic radius of caesium (1·63 Å) differs appreciably from that of potassium (1·33 Å), whereas that of rubidium (1·49 Å) is much closer to that of the latter element, rubidium can be accommodated much more effectively than caesium in the " normal " pegmatite minerals. The result of this is that, while no mineral exists in which rubidium is a dominant component, there is one in which caesium is and that is pollucite. This mineral is discussed further later.

Both caesium and rubidium are brought into solution by weathering processes, but they are strongly absorbed by argillaceous sediments and so sea-water and evaporites derived from it are comparatively poor in these elements. Nevertheless, despite this paucity, the potassium salts of evaporites are important sources of caesium and rubidium. However, these two alkali elements are also obtained in commercial quantities from pegmatite minerals and it seems that, if the economic importance of caesium approaches the expectations of many, deposits of pollucite will be exceedingly valuable. Already a number of zoned pegmatites are known which contain important concentrations of this mineral and outstanding amongst these are those of Varuträsk (Northern Sweden), Bikita (Southern Rhodesia), and Bernic Lake (Manitoba, Canada).

In all these deposits pollucite (the general properties of which are noted in Table 1) occurs in lenses associated more or less intimately with lepidolite and other lithium minerals, quartz, feldspar, etc. Pollucite, however—as Goldschmidt remarks (1954, p. 171)—" is not always easy to recognize because it has a peculiar similarity in surface lustre and transparency to the ordinary quartz of granite pegmatites " and it is

" probably less rare than usually believed." Because this important mineral is difficult to recognize by inspection and the application of simple physical tests the chemical aids, described below, have been devised.

Field Tests

It must be pointed out that a spectroscope—even a small one—will enable caesium to be detected rapidly and with certainty in a mineral, unless the element is present in very small quantities. It is only necessary to examine the lines which appear when a little of the powdered specimen (mixed, if necessary, with potassium bisulphate or bifluoride) is introduced into a flame on a cylindrical coil of platinum wire. Caesium is indicated by the presence of two strong blue lines (4555 and 4593 Å) which, when a small spectroscope is used, appear as one line.

Although this is an excellent laboratory method, a chemical test involving simple and cheap apparatus, a limited number of readily available reagents, and few operational steps, is clearly superior for work in the field. The *Northern Miner* (June 9, 1960, p. 15) reports that Kjollesdal has developed such a test for pollucite : it is, in fact, an adaptation of the well-known potassium bismuth iodide test for caesium (which is described in detail by Feigl, 1947, p. 182). Kjollesdal recommends placing first a drop of hydrofluoric acid on the sample to be tested and then a drop of potassium bismuth iodide ($KBiI_4$) reagent. The presence of caesium in considerable amount, and hence the presence of pollucite, is indicated by the immediate development of a vermilion precipitate. The reagents are carried in plastic bottles—that containing the $KBrI_4$ being brown—and they are dispensed by means of plastic pipettes or droppers. In Canada $KBiI_4$ may be obtained from British Drug Houses (Canada).

Table 1

General Properties of Pollucite

(*Based on Winchell's data, 1933, p. 293*)

Formula :—$Cs[AlSi_2O_6]H_2O_{<1}$.

Crystal system and habit :—Isometric ; sometimes as cubes, often massive.

Cleavage :—Only in traces.

Hardness :—6·5.

Specific gravity :—2·9.

Fusibility :—6.

Colour :—Colourless.

Optical properties :—Isometric : refractive index is 1·5215 in lithium light, 1·5247 in sodium light, 1·5273 in thallium light.

Although the test is rapid, simple, and reliable, it suffers from the great drawback that hydrofluoric acid is a very dangerous reagent which should only be used by those who are fully aware of its properties. Therefore the present writer suggests a modification in which a fusion with ammonium fluoride replaces the hydrofluoric acid attack. Ammonium fluoride is far safer to handle and to transport than the acid and though a source of heat is required to carry out the modified test this is not a real drawback, as even a match or a cigarette lighter can be used if no better means of heating are available.

Briefly, a little of the powdered sample is mixed with about twice its volume of ammonium fluoride and the mixture is heated until incipient fusion occurs. Fusion may be carried out in a silica crucible, on a piece of asbestos paper, or even in a capillary tube. The source of heat can be a Primus stove, an alcohol lamp, a candle, an open fire, or a cigarette lighter. If, however, a thread of the mixture—about 0·5 in. long—is packed into a capillary tube by repeatedly pressing the end into a small pile of the mixture the small charge can be adequately fused by the flame of a match.

Having carried out the fusion, a drop or two of $KBiI_4$ reagent is added to the product and the immediate development of a vermilion precipitate indicates pollucite. If the fusion has been effected in a capillary tube the end containing the charge is dipped into a drop of the reagent to complete the test.

Preparation of the $KBiI_4$ Reagent. (Feigl's method, 1947, p. 182.)

Dissolve 1 g. Bi_2O_3 in a saturated aqueous solution of 5 g. KI by boiling and treat the resulting solution with 25 ml. acetic acid which should be added in small amounts; store in a dark polythene bottle.

Methods of Staining Pollucite

Pollucite in thin and polished sections of rock and as grains in a plastic briquette may be readily stained by the method noted below and hence its distribution may be readily determined in such specimens. The technique is particularly valuable when examining thin sections as it enables rapid and certain differentiation to be made between pollucite and any other minerals which may be isotropic between crossed nicols. It is also very helpful when dealing with mill products.

Procedure

Clean the surface to be stained with

detergent in order to remove oil, etc., then rinse it in water and dry it on a hot-plate. If a thin section is to be treated cover the glass slide with a thin film of vaseline to protect it from subsequent attack by acid fumes. Carry out all subsequent operations under a well-ventilated hood. Select a shallow polythene container of such a size that the specimen can rest on it and fill this to within a quarter of an inch of the top with hydrofluoric acid. Place the specimen, with the surface to be stained facing the acid, on the container and cover the whole with an inverted polythene beaker. After about 2½ min. (experience may show that a longer or a shorter time may be necessary for the best results) remove the specimen (use rubber gloves) and press spot-reaction paper saturated with $KBiI_4$ on to the surface. (It may be necessary to dab the specimen several times with the reagent paper in order to obtain a satisfactory depth of colour.) This treatment causes the pollucite to be stained vermilion, while other portions of the specimen may be coated with the yellow reagent. Dry the specimen by holding it near a bunsen flame and then very briefly immerse it in water : this removes the unused reagent. Finally dry the specimen in the manner noted above.

If it is a thin section which has been stained, remove the vaseline by means of a paper handkerchief and coat the rock slice with a very thin veneer of 1 : 1 Durofix/amyl acetate, then allow it to dry below 50° C. Finally cover with a cover slip—using Canada Balsam as adhesive—in the usual way. (The Durofix mixture protects the stain during the subsequent heating and it allows any bubbles to be squeezed out after the cover slip has been placed in position without fear of the slice fracturing. In addition, it facilitates the transference of the slice to another slide should this be deemed desirable. After this treatment the pollucite areas, when examined under the microscope, appear to be densely stippled with red dots.

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Ore-Dressing Notes

(14) *Iron Ore*

A New Spiral Plant

Writing in the *Mining World* of San Francisco for January S. E. Sjöberg describes the treatment of a magnetite-hematite ore at Sweden's new Stora Kopparbergs mill. Preliminary test work showed that the magnetite should be separated magnetically but that, with the choice between tables, flotation, cyclones, and Humphreys spirals for concentrating the hematite, the last of these best suited the requirements. Flotation gave best grade and recovery but entailed undesirably fine grinding and a problem of sintering. The ore is crushed underground to *minus* 10 in., hoisted from a 2,000-ton skip pocket, and dumped into a 1,500-ton headframe bin. From here it goes through two stages of secondary crushing in Symons machines and thence, at *minus* 1 in. to the fine-ore bin. The mill building has exterior walls insulated by wood-wool panels. Structural steel is used for the machinery foundations to facilitate transfer of the machinery should the present layout be changed. Ore is fed at 150 tons per hour to two parallel rod-mills and reduced to *minus* 8 mesh. It then goes to magnetic separators with permanent magnets, where some 70 tons per hour are recovered as a 63% to 65% concentrate. The tailings pass on to a battery of 80 five-turn spirals which rough out a middling that goes from each spiral to a three-turn spiral below for cleaning, the reject returning to the rougher spirals ; 30 tons are recovered hourly at a grade of 63%.

This flow-sheet marks a considerable simplification from standard Swedish iron-ore practice. Following Minnesota's taconite practice cobbing has been eliminated. Concentrates and tailings are dewatered on top-feed filters, each of which handles up to 40 tons hourly. The 50 tons of tailing made hourly assays from 7% to 8% Fe and 2% P, the phosphorus content of the ore being 1%.

The article ends with a few working tips on the installation of the Humphreys spirals. An operating pulp density of 25% solids is recommended, maximum tolerance being 30%. Floor levels should allow the shiftsman

to observe the top spiral turn and collection below should be in large rubber-sheathed troughs inclined at 1 in 12 for tails, 1 in 6 for middlings, and 1 in 4 for concentrates. At first start-up of the new plant one pair of spirals (upper five-turn and lower three-turn) is adjusted accurately and used to produce calibrating angle gauges for its splitters. These gauges are then used for all the other spirals and the angle may not be altered by the shiftsman without authority. One man operates the whole spiral section. Principal costs are for maintenance and replacement due to wear of the cast-iron spirals, which last some six months and are to be replaced by rubber-lined ones. Meantime repairs are made by sticking on thin ribbons of Linatex. Spiral capacity is of the order of 1½ tons per hour, the appliance standing in 1 sq. yd. (one-tenth of the floor area needed by a shaking table).

(15) *Diamonds*

Dressing Methods Reviewed

Following an extensive tour in Africa current techniques in the treatment of diamondiferous material have been described by A. F. Daly in the *Mining World*, of San Francisco. From his notes it is apparent that all operations of any size start with gravity concentration coupled with screening and washing to produce a concentrate of diamonds and "satellites" (minerals of similar density which report with the values in such a concentrate) and end with hand picking.

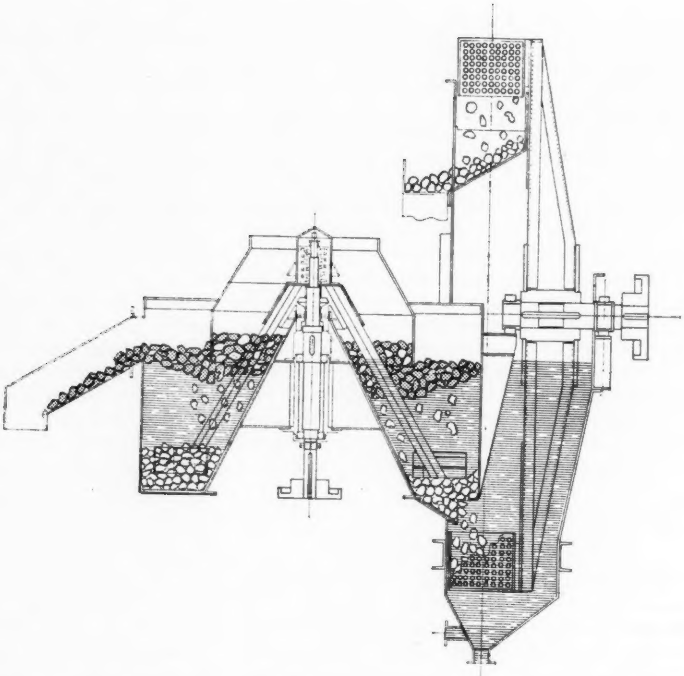
The diamond pan has developed considerably from its 1874 original and today it is from 4 ft. to 14 ft. in diameter with an outside rim 8 in. to 15 in. high and an inner one several inches lower, the central opening being about 0·3 of the outer diameter. Vertical rakes, mounted on from 4 to 10 spider arms plough the solids spirally outward, feed entering tangentially in the direction of rake motion ; the peripheral speed is adjusted to 300 ft. per min. Settled material is removed intermittently and includes only the roughed-out heavy minerals, the lighter fraction (puddle) overflowing inward. The new (1958) Kimberley plant treats 960 tons of ground hourly from three mines, starting with a *minus* 31·7 mm. head feed in 24 ft. pans and proceeding by a total of three stages, with intermediate recrushing, until a *minus* 1·65 mm. fraction from all pans goes to a 7 ft. heavy-medium cone. Puddle is maintained at a density of 1·25.

The alluvial mines of the Congo and Angola use pans and Harz jigs. The diggings are scattered and relatively small, so that portable plants are used, powered when necessary by diesels or steam. A trommel discards coarse stone and the undersize goes through a series of two pans, the final concentrate being sized and jigged. As there is little slime in the feed no heavy-medium or viscosity effect can be obtained and efficiency is lower than with the conditions at Kimberley. The work is described as "clear-water panning." There are eight small plants at Bakwanga working on alluvials and one which treats weathered kimberlite after it has been slacked off for about two years. A new central plant will obviate this tie-up and extra handling. The Ghana deposits may contain up to 32% of very sticky slime which balls up when being screened and washed. Such balls are hand-picked from the passing feed and given prolonged weathering. At two plants the gravel is disintegrated and deslimed ahead of the diamond pans.

Several new plants have started up outside the Union in the past few years and more are under construction. The Williamson mine in Tanganyika (1953) has a rated capacity of 400 tons hourly and uses two 12 ft. heavy-medium cones and hydro-cyclones with magnetite media for the *minus* 1·59 mm. *plus* 0·99 mm. material. Diamang started its Luxilo cone in 1956, handling up to 65 tons hourly, while in 1958 State Alluvial (Namaqualand) replaced its jig plant with cones handling 140 tons hourly. In 1959 the first section of the £3,000,000 Bakwanga concentrator began work on a mixture of alluvials and weathered kimberlite, the latter being treated in attrition mills (ball-mills using the rocks from the alluvials as grinding media). Washed material at *minus* 25·4 mm. *plus* 2 mm. is roughed in heavy-medium cones and the *minus* 2 mm. *plus* 1 mm. in hydrocyclones with magnetite media.

The trend of this considerable investment is toward the cone and cyclone pattern of development. Separating gravities are between 2·8 and 3·0 for roughing, with up to 3·3 for the second cone, when used. The advantages claimed are high capacity per unit area, good tolerance of feed fluctuation, high ratio of reduction per pass, high efficiency (up to 99%), and, perhaps most important, excellent security. The further working up of such concentrates proceeds on grease tables, with magnetic separation of ferro-

Norwalt Dense-Medium Separator.



magnetic satellites, flotation, attrition milling, and high-tension separation.

(16) *Coal*

A New Dense-Medium Washer

A new type of dense-medium coal washer has been developed in Britain and has been at work in an anthracite colliery in Natal since late 1959. Three more of these machines are at present being erected in South Africa. One classification of dense-medium separation is into " deep " and " shallow " baths, the Norwalt washer illustrated claiming to unite the best features of both types. The bath has a cylindrical drum, in the centre of which is the frustrum of a cone. Feed enters at the apex and is forced into the separating fluid by an annular curtain ring. The sinking fraction is gathered by push plates which stir the whole contents of the vessel with a slow rotating motion. These plates sweep the heavy fraction to the discharge arrangement, which can consist of a vertical wheel, a scraper, drum, or a bucket elevator. The capacity of the machine is from 50 tons per hour up, according to the diameter of the drum, and the depth of fluid in the bath is 3 ft. The solid fraction of the separating fluid is magnetite and the average drag-out loss is stated to be about 0·4 lb. per ton of feed. When shutting down the medium is drained into a stock tank, in which it can speedily be reconstituted by agitation with compressed air when starting up.

(17) *Flotation.*

Pyrite at Virginia, O.F.S.

The present flow-sheet of the pyrite flotation plant operated at Virginia O.F.S. treats currently mined ore after its gold and uranium have been successively leached. The pulp arrives at a density of 1·67 and a pH of 2·1 and is then conditioned with lime slurry to pH $4{\cdot}8 > 5{\cdot}0$, followed by collector agent and three stages of flotation. Describing the changes and the current method of treatment in the *Journal of the South African Institute of Mining and Metallurgy* for December, 1960, Zadkin and Doig start with the uranium leach tailing, after the ore has been given a " hot ferric leach " at 75° C. in which the concentration of sulphuric acid and ferric sulphate solution has been raised somewhat. Manganese dioxide is no longer used. The chemical condition of the particle surfaces

after this leaching is important, as is the make-up of the water used in pyrite flotation. Water from the Vaal River is good but expensive, while effluent from the local sewage works contains 75 p.p.m. nitrates, more than this concentration of sulphates, some phosphates, and stale synthetic detergents. At the same time underground water carries 0·4% sodium chloride and water recovered from uranium barren solution is high in nitrates and sulphates (about 1 gram. per litre). The effects of traces of detergent have now been met by using cresylic acid as the frother and the water now used is a blend of river, sewage, and recovered water.

Laboratory investigation of alternative collector agents has led to standardized use of mercaptobenzothiazole, which is more stable than xanthate. This sodium salt is readily soluble in water and in one or the other form it is an important ingredient of some commercial collector agents—*e.g.*, the Cyanamid 400 series. Test work showed that though this reagent costs twice as much as xanthate only one-third of the dosage is needed for comparable results. It has the further advantage for pyrite flotation that it is relatively insensitive to attack by a moderately acid pulp. As against a consumption of xanthate of about 0·14 lb. per ton, sodium mercaptobenzothiazole requires only 0·01 lb. per ton. As it is less sensitive to the presence of dissolved salts return water from the thickener can be used, which was found undesirable with a xanthate collector. A pH of less than 5·0 is used on pulp of density 1·33 containing 1·54% of sulphur, to yield nearly 90% recovery of sulphides containing 37% to 40% S and more than half the residual gold. This last is an improvement on the previous reagent effect. Cresylic acid at 0·122 lb. per ton is used after a conditioning time of about 16 min. The conjoint use of xanthate and mercapto was unsatisfactory.

(18) *Automation.*

Trends in 1960

A study of current literature—not omitting advertisements and patents—suggests that in milling work the use of automation is not only extending in scope and application, but also that it is cheapening and becoming more simple and reliable as the importance of mechanized control is better understood. Computing systems are already at work watching, integrating, and recalculating simple combinations of process variables and relaying their findings to automated control mechanisms. This, however, is still in its infancy. What appeared at first to be a frustrating answer to the millman's dream—automatic and instantaneous tailing assay—is now working at plant scale in the Anaconda operation, where an X-ray fluorescence technique scans mill slurries and warns the shiftsman immediately anything has gone awry. It receives piped samples from final tailings, final concentrates, and scavenger tails and can give either a continuous record for one product or can scan several in turn, with a flushing-out delay between changes which still allows a new assay figure every 2½ min. Up to five elements can be monitored in one system.

Automation has also reached the thickener, one plant having air probes on both overflow and underflow which switch excess feed to a holding pit and start reclaiming when supply runs short. The underflow probe regulates the speed of withdrawal by the slurry pumps. Another new idea is the on–off lime slurry control. With continuous feed for the purpose of regulating pH there is a tendency for lime to settle and plug the flow lines and apertures. If a cycle of, say, ten seconds is used the flow can be full on for any desired fraction of that time and full off until next required and the tendency for the transport lines to choke is reduced considerably.

Conveying Practice

We were recently afforded an opportunity of seeing two films designed to demonstrate conveyor installations by Hugh Wood and Co., Ltd., of Gateshead on Tyne, a manufacturing company which has been in operation for 50 years. The subject of one film was the Willoughby Lane Extensions of the Eastern Gas Board in which both raw coal and coke from the carbonizing plant are extensively handled by conveyor-belts. The second film was perhaps of greater interest to mining men as it deals with stone handling for aggregate production at the Owen Falls hydro-electric scheme at Jinja, at the source of the White Nile, in Uganda. It is understood that the company have made a number of other films to demonstrate the applications of their belt-conveyors and driving heads.

Book Reviews

Mines in the Spinifex: The Story of Mount Isa Mines. By GEOFFREY BLAINEY. Cloth, octavo, 242 pages, illustrated, with 23 plates. Price 27s. 6d. Sydney: Angus and Robertson, Ltd.

This fascinating account of early days in the Gulf area of Australia's Northern Territory and Queensland, leading to the successful outcome of Mount Isa's struggle for existence as a mineral producer, needs no other recommendation. "This tropical zone" of the sub-continent "nearly as large as India and ten times as large as Italy" has over the past century and a half been "except in the east" largely "a land of disillusionment." Mineral discoveries, arising out of the first search for gold, started about 100 years ago and led eventually to the development, exploration, and decay of the Cloncurry field after copper had taken over the running. The discovery of lead at Mount Isa was not made until 1923 and the first operating company was formed early in the following year. There followed years of struggle and in 1931 a new company, still Mount Isa Mines, Ltd., took over and managed eventually to bring it to production in 1931. Although the copper deposit in the hanging-wall of Mount Isa's Black Star had been discovered in 1930 it was not until the mine had been forced to close down as a lead-zinc producer in 1943 that the hopes of the Mount Isa community turned to copper as a means of survival. Thereafter the enterprise has deservedly grown to its present status, in the process having conquered in the "land of disillusionment" and fostered a now thriving community to content.

As the author says in an appendix, his book was commissioned by Mount Isa Mines, Ltd., and he has had all the facilities needed in the preparation of his manuscript. He has been able to consult many of the pioneers, still alive, and is to be congratulated on the result, an entertaining account of the pioneer days in Northern Australia and a record of which the sponsors can well be proud.

World's Non-ferrous Smelters and Refineries: Including a Classified Guide to the Metals and Alloys Produced. Sixth edition, 1960. Edited by H. G. CORDERO. Cloth, octavo, 451 pages. Price 80s., post free, London. Quinn Press, Ltd.

The new issue, the sixth edition, of this world-wide survey of leading non-ferrous smelting and refining plants, reviews hundreds of companies in some 60 countries, the details given including year of establishment, the head office, telegraphic address and telephone number, the directors, capital, location and description of plant, products output, and capacity, as well as details of processes employed, brands, sales offices and associated and subsidiary companies.

A new feature, a classified directory of non-ferrous metals and alloys producers is included in the 450 pages. In addition, special sections of interest are devoted to projected plants and works under construction, uranium metal producers, and to listing approximate analyses of some representative brands of antimony, tin, lead, and zinc.

The Mineral Wealth of Wales and its Exploitation: By TREVOR M. THOMAS. Cloth, octavo, 248 pages, illustrated. Price 30s. Edinburgh, I: Oliver and Boyd.

This book, a useful reminder that mining in Wales has not always been only coal-mining, describes the mineral resources of the Principality, in the process covering such raw materials as sandstone, limestone, slate, etc. Following a brief essay in geology the next two chapters deal with coal and its exploitation and the next two with the slate industry and the limestone industry. Then comes an account of igneous geology, followed by others covering sandstones, clays, and slates, etc., refractory materials, and sand and gravel. Next comes a review of the iron-ore resources of Wales and chapters on non-ferrous metals, including gold and copper. Two final sections cover manganese and other minerals.

The book, well produced and clearly illustrated, will provide a concise guide to all interested in Welsh affairs. The author rightly acknowledges much of his information on non-ferrous resources to authors in the Symposium on "The Future of Non-Ferrous Mining in Great Britain and Ireland" held in 1958.

Microwave Ferrites: By P. J. B. CLARRICOATS, with a Forward by H. M. BARLOW. Cloth, octavo, 260 pages, illustrated. Price 50s. London: Chapman and Hall.

In this excellently produced manual the author has aimed to provide engineers with an introduction to the microwave properties of ferrites, as well as to treat the theory and

principles of the usage of such materials in a manner that will help in component design. From the first empirical devices employing these unique materials theory has so far advanced that theoretical analysis now enables practical employment to follow final fundamental lines. Electrical engineers making use of such special materials will be grateful to the author for his treatment, while much metallurgical enjoyment can be derived from the account given.

☛ Copies of the books, etc., mentioned under the heading "Book Reviews" can be obtained through the Technical Bookshop of *The Mining Magazine*, 482, Salisbury House, London, E.C.2.

Charging Underground Blast-Holes

A new mixing and charging unit making possible the economical and practical insertion of mixed ammonium nitrate and gas oil in bore-holes of any angle and for underground blasting operations has been designed in Sweden by engineer Rolf Oscarsson, of Stockholm, in co-operation with the Boliden Mining Company. It is being marketed under the name of "Blu-Rox" by the Gothenburg firm of consulting engineers, Durox Export AB. It is claimed to overcome the difficulties which have previously prevented the full utilization of the advantages offered by NH_4NO_3.

For a number of years efforts have been made in many parts of the world to use to full advantage a mixture of ammonium nitrate and mineral oil as an explosive. So far only down holes have been used and even then no holes of diameters smaller than 6 in. To achieve a required density the ammonium nitrate has been mixed with melass, but results have shown that the explosive properties of the ammonium nitrate have not thereby been fully utilized. The prilling of the ammonium nitrate to pea size has also not met with the success expected of it and the process was costly.

It is claimed for the Swedish-developed machine that it gives the ammonium nitrate the density required without the addition of any extra aggregate. It mixes the ammonium nitrate with the mineral oil and loads the blast-holes pneumatically with the mix. The components are automatically measured in the machine so that a minimum of oxide of nitrogen and carbon monoxide is given off on detonation. This makes the use of ammonium nitrate for blasting operations underground possible and Sweden claims to be the first country in which this is being done. Today three Swedish companies, among them the Boliden mines, are using the Blu-Rox machine underground.

As standard, the machine is made for a quantity of 110 lb. of ammonium nitrate and a corresponding quantity of mineral oil, but machine size can vary with requirements. The built-in mixing device produces a ready-mixed batch in two to three minutes. The blast-holes can be loaded in any direction, including those drilled upwards and horizontally and blast-holes of diameters down to ½ in. can be dealt with. A 60-ft. hole can be loaded in one to two minutes and the material is packed so tight that no other components are required to give it exploding properties similar to those of dynamite. By a special complementary device the machine can be used for packing the ready-mixed ammonium nitrate in thin plastic hoses for use in water-logged holes.

Savings of time and costs and increased security are other advantages claimed for the new Swedish machine which has been recognized by the Swedish Workers' Protection Board.

J. GRINDROD.

Engineering Log

The brief ceremony of launching a modern liner is usually preceded by months of preparation. The timbers and structures which are to support the weight of the ship in the critical moments during which its static load is mobilized and transferred from land to sea have to withstand frictional stresses and to support enormous and rapidly-altering dynamic loads. The ship must then enter the water gently and be speedily brought under control. Several thousand tons of deadweight must be smoothly transferred from the keel blocks, shores, and packings to the launch packings and cradles on the sliding ways. Hundreds of these blocks are "split out" in planned sequence, this work proceeding continuously in the last 24 hours which end just before high water. Final decision to launch is made at the previous high tide and depends mainly on the local weather forecast. This decision marks the point of no return. Once the ship begins to settle on the greased slipway it must be launched before the

lubricants have been squeezed out. When the final moment arrives the weight is mainly borne by these greased ways and controlled by a series of synchronized triggers, beside each of which stands its group of operators who await the signal to remove the last locks, shores, pins, and wedges so that only an electrically-operated safety catch on the launching platform still holds the vessel. This catch is withdrawn as the sponsor is invited to name and baptize the ship. The movement which breaks the bottle of wine also activates solenoids which release the half-ton trigger levers. The ship stirs and gathers speed. Successively the fastenings of the drag-wires snap, the stern enters the water, and the propellers feel the sea for the first time and give a few spins. A cloud of smoke or steam rises from the forward cradle which has borne the greatest pressure. The ship reaches top launching speed—anywhere up to 30 ft. per sec. as the stern begins to rise and the hull to level off. Up to a thousand tons of drag-chain gouge trenches along the shore as their braking force is applied. Tugs link up, nosing through the floating timber which is already being salvaged for use in the next launch. The drag-wires are slipped. The liner is free of the land.

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Wire cloth, particularly the fine corrosion-resistant weaves which go into the filtration, screening, and papermaking industries, is a specialized product. Among the metals used are mild steel, brass, phosphor bronze, copper, and alloys of nickel with copper or chromium, and the austenitic stainless steels. Mild steel may be galvanized on tinned. Normally rolls are supplied in 100-ft. lengths at widths up to 48 in., 24 in. and 36 in. being the most in demand. Strips, squares, rounds, and non-planar shapes are to be had and there are more than 1,200 wirecloth specifications with wires as fine as 0·001 in. in diameter in the more fragile end. Plain weave is most in use for screening and for backing cloths in pressure filtration. Twill weave is used for larger wires and where strength is needed. More complex forms include multistrand, multiplex, and Hollander. For mosquito screens gilding metal (9/1 Cu-Zn) is favoured and for acid or alkaline filter cloths monel metal. A 4/1 Ni-Cr alloy is used for high-temperature work. For anti-corrosion at high temperatures stainless steel is the most widely used fabric.

* * *

The erection of Sheffield's new College of Technology on a bombed site with a fall of 60 ft. from north to south raised problems of foundation. Underlying strata consisted of clay shales, sandstone, and coal, and the position was complicated by the existence of mine galleries 15 ft. wide and up to 6 ft. in height directly under the proposed site. The various methods of filling these possibly caved mine workings which were considered included sinking a shaft, pneumatic stowing, and hydraulic stowing. Eventually pressure grouting was selected. It was only necessary to fill the galleries where they passed under the proposed buildings. They were therefore blocked by barriers at the required points to prevent grout from flowing away. The barriers were constructed by drilling 10-in. bore-holes from the surface and tipping pea-sized gravel in. When the gallery was full at a selected point this gravel was consolidated by cement grouting and formed an effective dam. On completion of this an aerated grout composed of cement and sand was pumped in through small-diameter bore-holes and topped up with a grout of ordinary Portland cement and fly-ash.

* * *

In the ordinary coal fire about a quarter of the heat is lost up the chimney and a new American invention—still in the experimental stage—aims to recover most of this. The principle on which it works is that used in the thermocouple made by twisting together two different metals, between which a current can be made to flow on heating. The thermoelectric generator is made of small pellets of lead telluride and the current generated is at least 20 times that of the pyrometric arrangement used in furnace temperature measurement. One possible arrangement would place the pellets in a domestic hot-water system. In another space heating is already performed by leading hot chimney gas past the back ends of the units, while cool air is ducted past the front ends by means of a fan powered by the current generated by the system. In reverse, refrigeration in miniature is being experimented with in cooling fluorescent lighting tubes.[1]

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A new steel-making plant is about to start up in western Arizona for the treatment of the desert black sands. The revolutionary Madaras process is to be used, in which

[1] *Lead*, 1960, No. 4

neither coke nor scrap iron is required. Initial capacity is set at 75 tons daily, with room to expand. A pilot plant was first successful in 1938 in Illinois and was followed up by a commercial unit in Texas handling 15 tons in one charge in 1940. Tests from 1942 to 1944 by the U.S. Bureau of Mines, covered in *Report of Investigation* 3924 (1946), stated the cost of the plant to be about one-fifth of that of blast-furnaces and coke ovens, with a low production cost for high-grade iron and steel. A full-scale operation in Mexico initiated in 1953 now produces 700 tons of iron daily. In the Madaras process iron and steel are produced direct from the ore by the use of reducing gas. This—a mixture of hydrogen and carbon monoxide—can be made from natural gas, oil, lignite, or low-grade coal according to local availability. A steel autoclave is filled with crushed or pelletized iron ore and heated gas is forced in, at a sufficient temperature to react exothermically with the oxides in the charge. By alternating entry of new gas and discharge of spent gas the whole charge is searched and reduced. From six to eight charges can be treated in a three-shift working day. The main advantage claimed for the system is that it permits exploitation of deposits remote from supplies of coking coal with relatively cheap and mobile equipment.

* * *

The resistance of the mineral oxides and sands used as refractories in furnaces depends on two main characteristics—their chemical constitution and that of the chemicals with which they make contact when at work. Refractories fall into four main groups—aluminous, siliceous, basic, and insulating. In the first three purity is important and, with the first two, absence of alkalis. With the fourth, which includes asbestos-kieselguhr-magnesia combinations, spun glass, and aluminium foil, stability under load is also important at working temperatures. In a recent lecture E. Masters [1] lists five questions which affect choice of refractory—temperature, stability under load, resistance to chemical attack from gases and/or slags, effect on adjoining brickwork, and effect on the material fed into the furnace. A highly porous brick is, broadly, low in crushing strength but resistant to spalling and to thermal shock. A denser brick is more highly refractory, emissive of heat, and strong and also resists slag-erosion better than one of cellular structure. The percentage of alkali is important since liquefaction begins inside the brick structure and not till this has occurred does slagging attack commence. Hence, some knowledge of the chemistry of refractory brick materials is important in considering service conditions. Acid silica must never touch basic magnesia, as their crystal structures would collapse with fusion well below a service range of temperature. Firebricks (Scotch or Stourbridge) are made of siliceous materials bonded with kaolin and react to form mullite which is very strong under high-temperature loading. Silica occurs as quartz, cristobalite, and tridimite, and siliceous materials include fireclays, rock ganister, and flint. During heating tridimite converts from the low-temperature A-form to B-cristobalite at 1,600° C., which melts at 1,710° C., volumetric changes accompanying these transformations, which must therefore be completed during manufacture. " Rammables "—plastic firebrick with a clay-bonded matrix carrying up to 7% moisture cover a wide aluminous range and can be rammed *in situ*. " Castables " are air-setting and start with a hydraulic bond which attains ceramic bonding at a high temperature. Both these latter materials are resistant to slag and shock and have a low coefficient of expansion.

[1] *J. Jun. Inst. Eng.* Jan., 1961

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Despite the official efforts to popularize the use of safety belts in motor cars little public interest has so far been shown in their uses. Three main types are available—the single " lap-strap " familiar in aeroplanes, the lap and shoulder harness, and the Swedish cross strap, fixed across from the door pillar to the transmission tunnel. The first of these, though simple, could be dangerous in a small car if the passenger were sharply folded about the middle and thus caused to dash his head against the dashboard or screen. The second, though most effective, is awkward to wear and fails to protect the head against " whiplash " effects. The present cost of a pair of front-seat outfits is between £10 and £20 and most drivers feel sufficiently protected by their steering wheel, so that they are apt to forget the more vulnerable position of their front-seat companion. A harness not only protects from accident ; it also saves a dozing passenger from injury during emergency braking. If one is fitted it must not be attached to the seat or to weak fixing points.

News Letters

BRITISH COLUMBIA

April 13.

Cominco.—The production of the Consolidated Mining and Smelting Co. of Canada, Ltd., during 1960 consisted of 77,832 oz. of gold, 8,690,224 oz. of silver, 160,079 tons of lead, 194,989 tons of zinc, 918 tons of cadmium, 124 tons of bismuth, 290 tons of tin, 664,132 tons of solid fertilizer, and 61,942 tons of liquid fertilizer. The consolidated revenue from all sources amounted to $117,254,540, as compared with $111,491,771 in 1959. After providing for income and mining taxes and depreciation of plants the consolidated net profit for the year was $23,497,740, dividends of $16,380,344 being paid. As compared with 1959 the higher earnings resulted from an increase in the price of zinc, together with improved returns from lead and fertilizers. The tonnage of ore extracted from the Sullivan mine was 2,522,554, against 2,440,396 in 1959. The 500-ft. extension to the main shaft was completed and work started on a new lower-level crushing chamber and conveyor gallery.

Production from the Bluebell lead-zinc mine at Riondel was 255,571 tons as compared with 251,366 tons in 1959. Shaft sinking to lower levels is progressing under the difficult conditions caused by subterranean water flows. At the H. B. zinc-lead mine at Salmo production was 464,408 tons against 463,504 tons in 1959.

The Con mill at Yellowknife, N.W.T., treated 190,626 tons, consisting of 114,541 tons averaging 0·51 oz. of gold per ton from the Con mine and 76,085 tons averaging 0·72 oz. from the adjoining Rycon mine. The phosphate mines in Montana produced 403,506 tons of phosphate rock to meet the requirements of the Trail and Kimberley fertilizer operations.

No further work was done at the important zinc-lead property of Pine Point Mines, Ltd., near Great Slave Lake, but extensive technical and economic studies have been made and discussions are now proceeding with officials of the Canadian Government regarding the proposed construction of a railroad to this area.

In New Brunswick, at the Wedge property, a vertical shaft was sunk to a total depth of 1,136 ft. and extensive underground exploration carried out. Production plans have been announced since the issue of the report and mill construction will be undertaken at once. Underground work at the Double Ed copper property at Anyox was further extended without finding any new ore. No other work is planned on this property at present. At the Duncan Lake lead-zinc property in the Lardeau District of British Columbia underground exploration was continued, establishing the existence of commercial quantities of ore. Further work is planned for 1961.

On Vancouver Island the mine of Coast Copper Co., Ltd., a subsidiary, is being prepared for production and a 750-ton mill is being erected at Benson Lake to commence production of copper concentrate in mid-1962. Sunro Mines, Ltd., in which Cominco has a majority interest, has leased its copper property on a royalty-per-ton basis to Cowichan Copper Co., Ltd., with production scheduled for late in 1961.

Lillooet.—In the year ended December 31 last Bralorne Pioneer Mines earned a net profit before depletion of $811,632. Proceeds from bullion and concentrate sales during 1960 was $4,723,232, while other income aggregated $256,820. Estimated recovery under the Emergency Gold Mining Assistance Act is $133,617. Production for the year was 141,086 oz. of gold from 203, 645 tons of ore milled. Ore reserves are estimated at 525,000 tons grading 0·85 oz. of gold per ton in the Bralorne mine and 64,000 tons grading 0·46 oz. per ton in the Pioneer mine.

At Bralorne, the Queen shaft was sunk 234 ft. to 24 ft. below 39 level and stations were cut on the 38 and 39 levels. The cross-cut to the 77 vein on the 38 level was advanced 400 ft. and to within 250 ft. of its objective at the year-end. The 79 vein was cut 350 ft. from the shaft and assayed 0·59 oz. of gold per ton across a width of 2 ft. At the Ace gold prospect the surface exposure was trenched for 800 ft., three surface drill holes were driven, and 500 ft. of adit put in. Drift values were lower than anticipated, but the work done is considered to have been justified.

During the first quarter of 1961 Bralorne Pioneer produced 25,607 oz. gold from 38,833 tons averaging 0·66 oz. of gold per ton. Production was down principally because it was necessary to draw heavily on low-grade upper-level stopes while conversion to sand-backfill cycle was underway on the deeper and richer levels.

Revelstoke.—The consolidated statement of Highland-Bell, Ltd., for 1960, shows concentrate sales of $891,086 (a new record) from the Highland-Bell mine and $177,132 from the Mastodon mine. The consolidated net profit for the year was $221,915. Highland-Bell has offered the shareholders owning the balance of

about 2·2% or 66,402 shares of Mastodon-Highland Bell Mines, Ltd., one share of Highland-Bell for three shares of Mastodon. If all shares are exchanged Mastodon-Highland Bell will become a wholly-owned subsidiary. Production at Highland-Bell during the year was 903,614 oz. of silver valued at $754,775 from 18,204 tons of ore assaying 51·70 oz. of silver per ton. Minor recoveries of other metals brought returns of $59,270 for lead, $54,270 for zinc, $17,528 for gold, and $3,324 for cadmium.

The operation of the Highland-Bell mine is being carried out under the same management and direction as before, with the advantage of the subsidiary company being entitled to deduct, in computing taxable income, capital cost allowance from depreciable assets of both companies as well as very substantial pre-production expenses incurred at the Mastodon property. It should be noted that because the Highland-Bell mine was operated by the parent company until December 28 the advantages outlined are not reflected in the year under review and taxes in excess of $116,000 are payable. That figure, however, gives some indication of the saving that may be contemplated over the next few years.

Nelson.—The output of Reeves MacDonald Mines for 1961 was 33,983 oz. of silver, 7,399,020 lb. of lead, 25,339,456 lb. of zinc, and 159,857 lb. of cadmium after the treatment of 411,282 tons of ore. Income from production was $1,965,262 ($1,970,276) and other income was $15,442 ($6,292). Figures in brackets cover the year 1959. The net income for the year was $66,722 (69,399). Mr. Jens Jensen, the company's president, explained to the annual meeting of April that when Reeves MacDonald commenced production in 1950 reserves were estimated between 2,500,000 and 3,000,000 tons. After extracting 3,281,837 tons in the following 10 years the reserves were estimated at December 31, 1960, at 3,510,783 tons. He said the mine was responding most favourably to development. The internal shaft was now at a depth of 1,200 ft. below the 1,900-level adit and diamond drilling had confirmed persistence of the main ore-body to a further vertical depth of 500 ft. without diminution in size or grade. Accordingly shaft sinking will be continued to the newly indicated depth. Reeves MacDonald is to embark on an ambitious drilling programme on a large tract of favourably-situated ground near the Sullivan mine. Five anomalies have been found in geophysical surveys.

EASTERN CANADA

Ontario Gold Output.—The output of the gold mines of Ontario for February included 214,763 oz. of gold and 33,291 oz. of silver, valued at $7,465,046, from 737,859 tons of ore milled.

Manitoba.—Speaking at the annual meeting of International Nickel Co. of Canada held in Toronto on April 19 the chairman, Mr. Henry S. Wingate, said that the enterprise at Thompson, opened in March, should be operating at a rate of more than 75,000,000 lb. of nickel annually " in a matter of weeks."

North-Western Ontario.—The report of the Anaconda Company for 1960 records that the 100-ton pilot plant at the Nakina iron-ore property of the Anaconda Co. (Canada), Ltd., started operation in the year under review. Bulk samples from three representative sections across the Briarcliffe ore-body had been treated at the plant and results had shown that a very high-grade iron concentrate can be produced. " Depending upon the optimum economic relationship between grinding cost and sales price of product, the concentrates will contain 68% to 71% iron, 1·25% to 3·5% silica, 0·017% phosphorus, and 0·007% to 0·027% sulphur. Similar test work is proceeding on ores derived from the Two Mile ore-body located nearby."

Quebec.—The report of the Quemont Mining Corporation for 1960 shows that the operating profit, after taxes, amounted to $2,394,750 as compared with $2,648,990 in 1959. The net profit, after provision for depreciation, amounted to $1,999,339, or 95 cents per share, as compared with $2,072,333, or 99 cents per share in 1959. The concentrator treated 856,632 tons of ore, of which the average grade was : 0·147 oz. of gold and 0·81 oz. of silver per ton ; 1·30% copper, 2·60% zinc, and 35·4% pyrite. The indicated ore reserves at the end of the year totalled 5,340,000 tons, averaging 0·174 oz. in gold, 1·05 oz. in silver, with 1·29% Cu, 2·75% Zn, and 50% pyrite.

Mining Corporation of Canada.—The report of the Mining Corporation of Canada for 1960 shows a profit for the year of $1,927,027, or 90·3 cents per share, as compared with $1,667,564, or 78·1 cents per share, in 1959. The increase is due to the commencement of dividend payments by Geco Mines, Ltd., in the third quarter, after it had paid off its loans.

FAR EAST

April 14.

Malaya.—Pioneer status is to be accorded the aluminium rolling mill to be built in Malaya by Aluminium, Ltd., of Canada, through a new subsidiary—the Alcan Malayan Aluminium Co., Ltd. In this way the company will be granted tax and other concessions. The site is at Petaling Jaya industrial town and the mill is expected to cost about (Malayan) $4,000,000.

Increased demand for engineering supplies has resulted from the high price of rubber, the revival of the tin industry, and expansion of the iron-ore industry. Government development programmes have also contributed to this improvement. The outlook for 1961 appears encouraging and many importers have reported a good " on order " position.

Mr. S. A. Anderson, chairman of United Engineers, Ltd., of Singapore and the Federation of Malaya, has reported a considerable improvement on the heavy industrial side of the business towards the end of 1960, due largely to the lifting of tin restriction and the bringing back into full production of many dredges. This appears likely to continue for some months ahead. The company's balance sheet for 1960 shows that the profit before taxation was (Malayan) $967,000, against $816,000.

Indonesia.—A six-man mission from the Japan Steel and Tube Corporation has surveyed iron-ore deposits in the Tjilatjap area and reported that results were encouraging.

China.—The last consignment of Polish machinery for a cement works arrived in the country recently. Some 2,000 tons of modern equipment, including grinding mills and a 150-m. revolving furnace, was delivered in the course of last year. The works will have a capacity of 150,000 tons annually.

The scale of China's largest steelworks is indicated by the news that almost 80,000 tons of iron ore, coal, limestone, and other materials were arriving every day at Anshan last December.

The petroleum plant at Kochow, Kwangtung, has been successfully extracting oil from shale and producing petrol, diesel oils, lubricating oils, and paraffin for local use.

The Tsingtao branch of China's National Minerals Corporation recently advertised that " We are sellers of minerals and ores originating in China and are able to offer on overseas markets the following items." It listed asbestos products, barytes lumps and powder, fireclay (raw and calcined), flake graphite, flint pebbles, fluorspar lumps and powder, magnesite (crude, caustic, and dead burned), talc lumps and powder, etc.

Hong Kong.—Hong Kong's production of iron ore during the third quarter of 1960 amounted to 30,048 long tons, as compared with the total of 29,645 long tons produced in the corresponding period of 1959. All the ore was exported to Japan.

Graphite of high quality was shipped to the U.S.A., Britain, and Thailand.

SOUTHERN AFRICA

April 24.

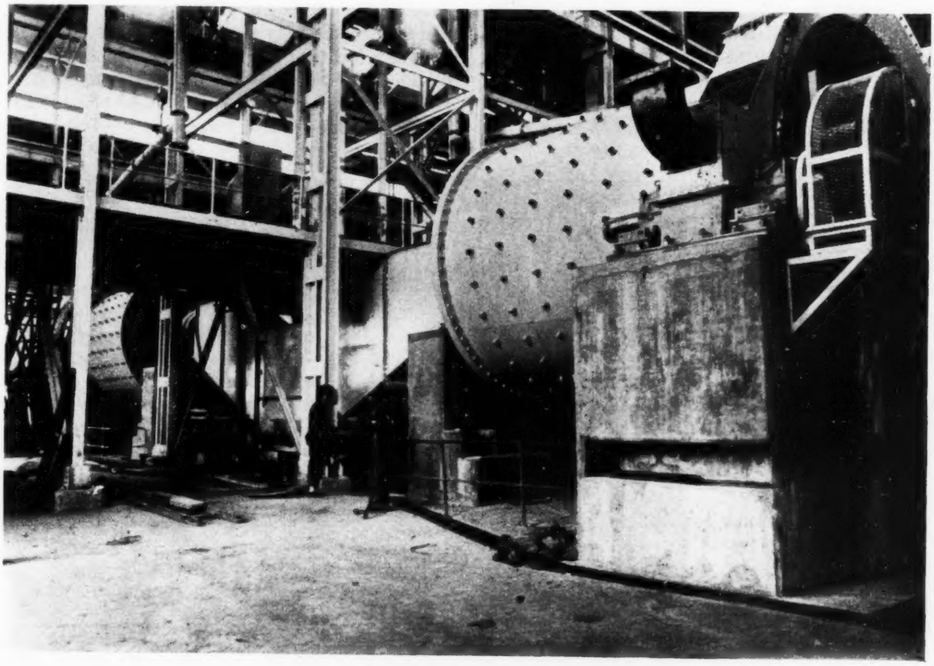
Congress Party in the Cape.—On the occasion of the visit of Congress delegates to its mines in the Postmasburg and Kuruman areas, South African Manganese, Ltd., released some details of its operations there and particularly of its new " Hotazel " manganese mine. In general its manganese mines are producing eight different grades over the range 30% to 50% Mn, the ore being hard and lumpy with low phosphorus (0·05%). Current output is about 250,000 tons a year, largely of the 36% to 40% Mn grade, all of which is exported. At the Hotazel mine the saleable ore reserves have been estimated at 20,000,000 tons being exploited under a Government mining lease. The mine has now been connected by a rail-link with the Sishen rail-head.

A geophysical survey, employing magnetometric methods, led to the discovery of the " Hotazel " and other Kuruman deposits under sand and banded ironstone. The current output rate is 40,000 tons a month of crushed and screened manganese ore, in three grades between 40% and 52% Mn, hard and lumpy and low in phosphorus, half for export and the balance for domestic consumption. To achieve this rate of output overburden of 22,000 cu. yd. of Kalahari sand and of 120,000 tons of banded ironstone must be removed monthly. The sand overburden is now being stripped by an L.M.G. bucket-wheel excavator, which, at present loading into four converted International Harvester RDF 320 rear-dump trucks each of 13 cu. yd. capacity, will eventually discharge on to a conveyor-belt system to the waste-dump.

The geological section as exposed at present shows from surface a 42-ft. sand overburden, followed by a progressively thicker banded-ironstone bed, a 20-ft. manganese-ore bed, a

70-ft. banded-ironstone bed underlain by a 65-ft. manganese-ore bed, and, finally, the widest or deepest banded-ironstone bed, all resting conformably on lavas. It would appear that the hydrothermal deposits between the sand overburden and lava foot-wall dip from north to south, with fairly well-defined hanging- and foot-wall contacts and face contacts on the outer limits of the banded-ironstone and associated manganese beds, with the surrounding limestone. Following initial stripping of a section of sand overburden, an east–west haulage road, gradient 8%, was developed on the northern limit of the deposit down to the base of the lower manganese bed on the western boundary. The face of the sand overburden is advanced well ahead of the position of the lower faces and mining of the lower alternating banded-ironstone and manganese beds is conducted in benches, each served by a branch road from the main haulage road. Blast holes are drilled by crawler-mounted Ingersoll-Rand and Gardner-Denver wagon-drills, the 3-in. diameter holes being spaced 10 ft. by 10 ft. and, used only in the middle 70-ft. thick, hard banded-ironstone, by an Ingersoll-Rand Crawl-master down-the-hole unit, drilling $4\frac{3}{4}$-in. holes, spaced 14 ft. by 14 ft., to the full depth of this layer. To maintain the correct floor-level on dip, 3-in. lifter holes are drilled into all the bench faces. Blasting—

Radiometric Sorter.



Mill Unit in the E.R.P.M. Plant.

with electric firing by Cordtex—is by 50% ammon dynamite (22 in. by 2½ in. cartridges) and by Free-flo in 12½-lb. packets, primed with a blasting cartridge and only used in vertical holes.

Loading on the various benches is effected by seven Ruston-Bucyrus shovels—three of 2½ cu. yd., three of 1½ cu. yd., and one of 4½ cu. yd. The receiving and haulage equipment consists of eight 22-ton Le Tourneau-Westinghouse articulated rear-dumps, four 18-ton and five 27-ton Euclid rear-dumps.

Electricity Supply Commission power is expected to be made available to the mine by late 1962. In the meantime power is generated on the mine at 3·3 kV. by two Mirrlees diesel engines, the 8-cylinder unit being direct-coupled to a 620-kW. and the 6-cylinder unit to a 380-kW. Brush alternator. A 4-cylinder McLaren diesel, direct-coupled to a Brush 45-kW. alternator, supplies standby off-peak power. Bore-holes, 10 to 14 miles east of the mine, with Beresford 34-stage submersible 5 in. diameter pumps 500 ft. from surface, supply an adjacent 100,000 gallon reservoir on a hill in the Asbestos Range, whence the water gravitates to the mine with a head pressure of 100 p.s.i.

Run-of-mine ore is fed by an electronically-controlled apron-feeder to a 42 in. by 48 in. Birdsboro-Buchanan jaw-crusher (4½-in. setting), the crushed product being elevated to a 14 ft. by 5 ft. Telsmith vibrating screen (2½-in. mesh). The *minus* 2½-in. fraction is screened on two double-deck units to remove the *minus* ⅜-in. fraction, the oversize passing to two 42-in. sorting belts. The *plus* 2½-in. fraction is transferred *via* a third 42-in. sorting belt to a secondary Telsmith 13B gyratory crusher (2½-in. setting), the product being screened to remove the *minus* ⅜-in. fraction, the *plus* ⅜-in. fraction with the similar fraction from the first two sorting belts being transferred to a shuttle-belt delivering to the stockpile system, which has 26 draw-off points in a tunnel served by four movable vibrating feeders. These feeders can be moved to appropriate blending positions and feed a retrieving conveyor-belt and shuttle-belt system that loads trucks on a weigh-bridge. The plant is rated for a maximum 300 tons an hour.

Sampling is effected at the manganese faces to facilitate selective mining and ore passing through the plant is again sampled. The blend, being loaded into the trucks, is sampled before despatch. The samples are analysed in the mine's laboratory. The purpose of the sampling is to ensure that requisite grades are railed and sampling is effected at specific points to that end.

The mine's modern workshops are equipped to undertake forging, shaping, milling, turning, drilling, and precision grinding to a degree securing maintenance of most of the mine's plant and machinery in an isolated area.

Communication with the mine is maintained by telephone and a two-way radio-telephone link from the Johannesburg head-office and among the associated mines. In addition a

Stelek Electric Loader.

Blair Low-Head Loader.

twin-engined Piper aircraft provides a shuttling service among the group's properties and with the nearest commercial airways terminals.

Electrically-Driven Underground Loader.—Interest and demand for an electrically-operated loader was reflected in the development and manufacturing of the Taylor " Stelek " electric shovel loader by a company associated with Gold Fields of South Africa, Ltd., now trading under the name of Hunslet Taylor Consolidated (Pty.), Ltd. The loader is claimed to have been designed on lines suitable for South African mining conditions. It is simple in operation, robust in construction, easy of maintenance, and promotes efficiency and economy. It can be adapted to pneumatic operation. Its advantages are summarized as follows : Per horse-power produced, electricity costs are about one-fifth of air-power costs. (This disparity is increased further by including amortization charges on increased compressor plant and reticulation for the maintenance of air pressure with extended use of air-operated machines.), full power operation is possible in contrast with pneumatic machines, because air pressures vary and the latter's efficiency declines rapidly with wear in the air-powered unit, and maintenance effort and costs are lower than with pneumatic machines.

The driver of the " Stelek " loader is seated on the side of the body, controls the forward and reverse motions of the wheels by a single hand lever, and the digging, hoisting, and lowering of the shovel by a foot-operated pedal, and availing himself of the wide slewing range provided, can traverse the turn-table carrying the rocker-shovel by means of a hand-slewing wheel, with a patented self-centring device returning the shovel to its central position. A feature of the " Stelek " is its great power ; the design incorporates a single squirrel-cage electric motor running continuously in one direction. Its crowding action is such that a full load is possible for each complete cycle of the rocker-arm. The speed of hoisting is variable—from " creep " to full rate—and it is therefore possible to load into short 1-ton cars or long 4-ton trucks. Averages of over 2 tons of rock per minute can be maintained with ease.

Blair Low-Head Mechanical Loader.—Still in the development stage—with the introduction to mining practice keenly awaited—is the Blair low-head mechanical loader, a prototype of which is illustrated in the accompanying photograph. Outstanding features of the machine are its applicability to excavations of limited headroom — *viz.*, narrow stopes dipping at any angle less than the angle of repose of the broken rock—its light weight, relatively low power consumption or requirements, wide slewing action to handle ore-piles greater than the width of the machine, and the range of mountings—skids, rubber or steel wheels, or endless tracks. The capacity of the

prototype is given as 50 to 60 tons per hour, variable according to the type and fragmentation of the rock. Its dimensions are 31 in. high, 40 in. wide, and 86 in. long.

The loader consists of a movable chassis, on which is mounted at the forward end an open-ended flared scoop and a toothed leading-edge, and behind the scoop a belt or other receiving means, such as a hopper. The scoop can be moved in an arc positively up and down by the reciprocating arms (air-operated in the prototype) mounted on each side of the chassis. The upward movement causes the material in the scoop to flow or be thrown back on to the belt or receiving means. Also mounted on the chassis, above the reciprocating arms, are the two friction capstans (one on each side), which can be driven independently to impart the slewing movement. Coiled around each capstan is a guide-rope. Each forward-end of the two guide-ropes is rigidly mounted—*viz.*, at the top of the stope face. The rearward ends are connected to pistons of rigidly-mounted pneumatic jacks, which apply the predetermined tension to the ropes. The loader is propelled, forwards and backwards, along the ropes by the rotation of the capstans.

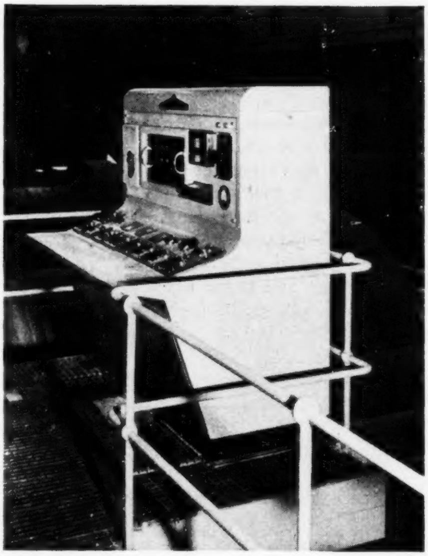
Two main operations of the loader are envisaged : (1) As a stope cleaner or mucker ; (2) as a shuttle-transport. In the first application the loader is propelled upwards or forward into the broken rock with the scoop forward and in its lowermost position. Before the loaded scoop is raised to discharge backwards the loader is reversed slightly. Emptied, the scoop is lowered and the loader again propelled forward into the broken rock. The cycle is repeated until the belt-section or receiving means is filled. The loader is then reversed down the stope or along the excavation to discharge into gulley cars or cocopans or on to an extensible conveyor or other means of transport. The invention also envisages the installation of portable hoppers conveyed along the rear-sections of the rope-guides or along other ropes along the working face. In the second application, as a shuttle-transport, the receiving means would be a hopper ; as such the loader could be used in coal mining.

Transvaal.—West Rand Consolidated, which is expected to be the only primary uranium producer in production in 1970 under prevailing conditions, has still very substantial reserves of uranium oxide in its Bird Reef Series and estimates that the tonnage remaining in the mine at 1979-end will exceed total production in the preceding decade. The company therefore has considerable potential to participate in economic business offering after 1970. In the stretch-out period from 1961 to 1970, however, after taking into account quotas acquired to facilitate the stretch-out, annual profits available for distribution will be reduced by about one-quarter in 1961 from 1960 levels and by one-half in 1962 and subsequently. The company has a 20% interest in Electrolytic Metal Corporation (Pty.), Ltd., which in 1960 expanded production of electrolytic manganese to the full capacity of the plant's first unit. Demand for output exceeds capacity and accordingly output capacity is to be doubled, expenditure thereon to be covered by temporary loan arrangements and appropriations from profits. West Rand Consolidated company will acquire a 20% interest in the re-organized capital of the Palmiet Chrome Corporation (Pty.), Ltd., which will set up a works on the mine property to produce ferro-chrome and allied products. Certain portions of the mine's South Gold Plant will be incorporated in the new works.

The new central gold plant of East Rand Proprietary Mines, Ltd., was commissioned for production in the first quarter and is operating satisfactorily. During the trial milling period, while the other two old plants ground to their final stages of production, the new plant was run in with low-grade Kimberley Reef ore, development results from which horizon do not figure in the normal development returns. This method of running-in probably minimized gold absorption and therefore lock-up and loss of yield, which might have been much more appreciable if the running-in had been conducted with normal mill-feed ore. The company has applied for a lease over an additional 252 claims adjoining its present southern boundary.

Koepe winders are to be operated in the vertical main hoisting components of both the No. 2 and 3 twin-shaft systems of Western Deep Levels, Ltd. The No. 2 main vertical has been completed to a depth of 6,309 ft. and the No. 3 main to 6,354 ft. Both are very deep lifts for the Koepe winder. The two main shafts, of which both vertical components have been completed, will also have sub-vertical components. In each system the ventilation components will be sunk in one stage to their final depths. Initial milling operations are now scheduled for late 1962. The surface rail-line from West Driefontein's No. 5 shaft to Western Deep Level's No. 2 system has been completed.

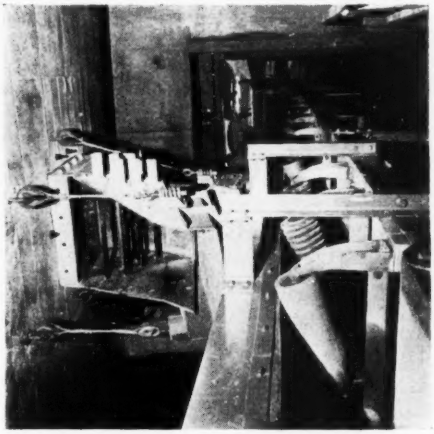
Vaal Reefs Exploration and Mining, which has completed sinking the main hoisting



Electronic Control Panel.

component of its No. 2 system to a final depth of 7,052 ft. and the ventilation component to 6,868 ft., has virtually completed the installation of a Koepe winder in the main component. The gold plant is nearing completion in respect of extensions, which will raise milling capacity to the 125,000 tons a month range.

An accompanying photograph shows the control panel of a 12 ft. by 16 ft. milling unit at Winkelhaak mines. Push-button switches control the 900-h.p. mill motor drive, the roll-feeders under the silo bins, the variable-speed controls of the roll-feeders, the fine-ore belt-feeder, the mill discharge pumps, the variable-



Williamson Controller to Pebble Belt.

Thickeners at E.R.P.M. in Concrete Tanks.

speed control of these pumps, and a locking switch of the main mill motor to ensure its isolation whenever personnel are inspecting or relining the mill. In addition the control panel houses the recording ammeter, the integrating kWh. meter, and the Williamson pebble-feed controller.

At Doornfontein Gold Mining underground exploratory drilling has shown that the approximately north–south strike of the Carbon Leader horizon is situated further west than previously plotted and that therefore the claim area probably underlain by the horizon may be appreciably greater than previously estimated.

At Buffelsfontein the ancillary sub-vertical shaft in the shaft system serving the north-western section has been completed to its final depth and the Ward Leonard man-hoist commissioned. Extensions to the gold plant are nearing completion.

Orange Free State.—With the extension of underground development operations into higher-grade zones Welkom Gold Mining recorded substantially higher sampled values on the Basal Reef in the first quarter of the current year, the average being 569 in.-dwt., against 528 in the six months to March, 458 in the preceding year, and 403 in 1958–59. The last ore-reserve grade was 322 in.-dwt. and the indicated bore-hole grade range 322 in.-dwt. to 444 in.-dwt.

Trade Notes

Brief descriptions of developments of interest to the mining engineer

Recording Flame Methanometer

Some particulars have been made available by the makers of an instrument for the continuous detection and recording of the changing density of combustible gases present in the atmosphere. This, known as the Sigma recording flame methanometer, has been developed by the Mining Research Establishment of the National Coal Board and is manufactured by the **Sigma Instrument Co., Ltd.,** of Spring Road, Letchworth, Herts., under licence from the Board.

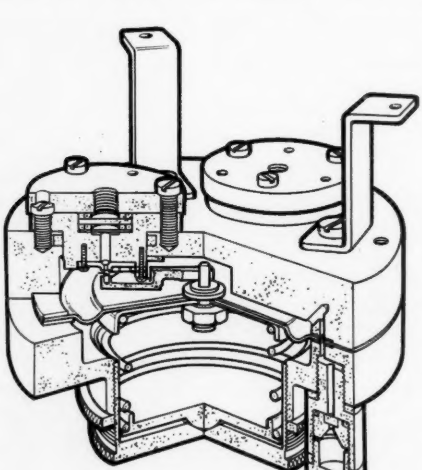


Fig. 1.

The methanometer will give a record of up to 3% of combustible gases. The basic principle is a constant burning butane flame in a gauze chamber fed from a high-pressure butane tank and such that the jet and the flow of the fuel is controlled by a precision-built Miniflow governor (Figs. 1 & 2) which maintains in uncontaminated air a non-varying flame. The hot waste fumes from the flame pass a ring of thermo-couples. With unpolluted air the temperature of the flame and waste fumes remains constant and the pen recorder, connected electrically to the thermo-couples, gives a continuous zero reading. When, however, the air supply to the burner is contaminated by combustible gas there is an increase in the temperature of the flame and of the exhaust fumes, which raises the output voltage of the thermo-couples and so the recorder pen is deflected. A continuous recording is made on a calibrated chart (Fig. 2) giving the density percentage of combustible gases present. A special laboratory model is also in production

Fig. 2.

which will provide a visible and audible indication of the presence of combustible gases.

Seismic Drill Rigs

In the course of seismic and radioactive surveys being undertaken in Libya a complete mobile unit comprising an air-compressor, air hoist, drill, rods, bit grinder and accessories (as illustrated), powered by a Cummins diesel engine is being employed. It is reported that in initial trials this Anglo-American enterprise has succeeded in completing a 20-ft. shot-hole in 4 min. using 1½-in. round steels with 2-in. X-type T.C. Joy bits.

The unit is compact and stable and can be supplied with a variety of drifters for various applications and hole depths. The TM.400B with ⅜-in. air tube as used in Libya will drill to 24 ft. with steels up to 1½ in. and a similar drill, but having an air tube of $\frac{9}{16}$ in.—the TM-4—will drill to 40 ft. with coupled steels of 1¼ in. or 1¾ in. diameter. This faster drill is of particular value where broken ground or sandy overburden is encountered.

The larger air tube gives superior hole cleaning and reduces wear on the bit. Drills of 4½-in. bore, the TM-450 and TM-450 dual rotation, will drill holes up to 4 in. diameter 40 ft. to 60 ft. and 100 ft. deep respectively. All these drifters can be used with the Joy Airvane RP. 600 compressor on the rig, but a Junior Seismic model mounting the Airvane 365 compressor and TM. 350 drifter is also available for lighter work and shorter holes.

There are several ways in which radioactivity in geological work is measured, the most frequent being the placing of a Geiger counter at the collar of the hole where it can record the degree of activity in the cuttings as drilling proceeds. The steels are marked at intervals with chalk so that recordings are easily noted of the depth at which any degree of activity is present. Another method is to lower a probe of the counter down the completed hole on the end of a calibrated line.

Mobile Drill Rig.

These notes are supplied by the Air Power Division of **Joy-Sullivan, Ltd.,** of 7 Harley Street, London, W. 1, who are working in association with the **Joy Manufacturing Co.,** of Pittsburgh.

Quarry Ripping

The development of a refraction seismic technique for the measurement of the degree of consolidation in surface rock has enabled the

Caterpillar D9 with No. 9 Ripper.

Caterpillar Tractor Co., of Peoria, Illinois, of whom Bowmaker (Plant), Ltd., of Birmingham, 16, are agents, to proceed actively with the development of heavy-duty tractor-mounted rippers. It has been shown that for many conditions the use of rippers can reduce earth and rock-moving costs appreciably and this has led directly to the design and application of seismographic equipment capable of correctly assessing the likelihood of success in a particular case. To this end a portable seismograph with its attendant geophone are used in conjunction with an 8-lb. sledge hammer and a 1-in.-thick steel plate. By a blow on the plate a seismic wave can be produced at measured distances from the receiver and an assessment made as to whether the formation is rippable or not.

In a demonstration staged at Merehead quarry, near Shepton Mallet, Bowmaker (Plant) showed two power-shift D9 tractors fitted with hydraulically-operated bulldozers and Caterpillar and Kelley hydraulic rippers ripping in bed-rock, the first time, it is believed, that tandem ripping has been demonstrated to the quarry industry in the United Kingdom. One of the machines is shown at work in the accompanying illustration. When ripping, the tractor lowers the ripper into the rock to the depth it is able to maintain in the hardest areas. The tooth is lifted clear, the tractor turns, starts another run until the area has been ripped, and then repeats the process. The ripped rock is either bulldozed over the face to stock, or picked up directly by Traxcavator or scraper. A 3-in. thickness of ripped material should be left in order to provide traction on the next ripping phase and to cushion the tractor.

Personal

O. M. Bulman, Woodwardian Professor of Geology in the University of Cambridge, has been elected a Fellow of the Imperial College.

I. Cairns has been appointed consulting development engineer to the Anglo American Corporation of South Africa, Ltd.

F. S. Clarke and A. B. McElvie of Laporte Industries, Ltd., were recently in Western Australia.

K. A. Fern is home from a visit to the U.S.A., where he spent some time at the American Cyanamid Company's Princeton laboratories, studying the application and handling of AM-9 chemical grout.

B. H. Howell has left for Sierra Leone.

D. H. Mansfield has been appointed a director of General Tin Investments, Ltd.

R. E. Moore has succeeded Lieut.-Colonel S. C. Guillan, who retired on April 30, 1961, as secretary of the Institute of Metals.

Derick Morris is returning from Ceylon.

A. J. Pallett is returning from Ghana.

A. J. Perry has left N. Rhodesia for Queensland.

M. L. Southwood Jones is now in New South Wales.

J. Ivan Spens has been appointed President of London Tin Corporation, Ltd.

T. E. Vaughan is home from Chile.

J. H. Watson, chief assayer, Royal Mint, has been elected a Fellow of the Imperial College.

W. D. Wilson has been appointed a director of the General Mining and Finance Corporation, Ltd.

B. B. Young is leaving for Ghana.

Michael Falcon who died in South Africa on March 26, aged 58, went from Cambridge to the Royal School of Mines in 1925. After gaining his Associateship in mining in 1927 he returned to South Africa, where he worked in various official capacities. In 1952 he was appointed technical adviser to the Transvaal and Orange Free State Chamber of Mines. Mr. Falcon was prominent in the affairs of the Royal School of Mines Association in South Africa and had acted as Chairman of the South African Executive Committee for the Seventh Commonwealth Mining and Metallurgical Congress.

Cecil William Dannatt died on April 9, aged 68. Professor Emeritus of Metallurgy in the Imperial College of Science and Technology he had graduated from the Royal School of Mines in 1914. After service in the Forces in the 1914–1918 war he returned to the School of Mines in 1923 as a research assistant after five years spent in travel. Soon appointed to the teaching staff he became Assistant Professor to the late Sir Harold Carpenter in 1937 and Acting Director of the Metallurgy Department when Sir Harold died in 1943. In 1945 on the return of the Department to London from Swansea he was appointed Professor, a post he held until 1957. In 1960 Professor Dannatt was elected a Fellow of the Imperial College. He was a past president of the Institution of Mining and Metallurgy and a vice-president of the Institution of Metallurgists.

Metal Markets

During March[1]

Copper.—April has been marked by the emergence of a clearly strong sentiment about copper. In past months the attitude has been one of waiting to see what would turn up next to keep the disappointing world statistics for the industry in the background. During April, however, the emphasis has swung round to questioning the figures in the light of the encouraging nature of industrial news. Perhaps the mainspring of this reversal has been the strength of the position in the U.S.A., where two factors have contributed to the better tone of copper there. The first is the improvement in activity by the brass mills, whose sales have shown a useful advance, while the second is the growing strength of copper scrap in the U.S.A., triggered off some time ago by heavy Japanese buying. This strength has now reached the point where the custom smelters are under some pressure to raise their selling price for copper, although there are various other factors that temper the urge to do this.

In Europe consumption has actually gone a little stale, although not sufficiently seriously to deter the better sentiment. Perhaps the trial time for the improved feeling about the market came in the middle of the month, when Kennecott Copper announced that its U.S. mining operations were being put back on a seven-day week basis from a six-day week previously. There was a good deal of murmuring at this move, coming at a time when other world producers were making sacrifices to restrict production in the interest of the stability of the market. However, as was noted last month, the end of the current wage contract between Kennecott and their union in June is widely thought to presage a strike and the increase in output can be taken to be merely a precautionary move in advance of that possibility. At all events it did not take the market long to decide that it was not greatly perturbed by the development, notwithstanding the fact that very shortly afterwards Sir Ronald Prain, chairman of Rhodesian Selection Trust, suggested in a speech in London that the current world statistical surplus was of the order of 150,000 tons a year. It is not being unkind to Sir Ronald's judgment to point out that when, a little while later, he spoke in New York, he was anxious to point out the importance of the improved position in the U.S.A. as a market factor. World capacity is continually being added to and it is hard to see any time in the next few months when any foreseeable increase in consumption or decrease in supplies can result in the present trend being carried to major lengths. On the other hand, the opinion now is that copper at £230 is not too dear, whereas a few months ago it was thought in some quarters to be dear at £220 !

Copper consumption in the U.K. in February was 55,946 tons, including 43,777 tons refined. Production of primary refined was 10,782 tons and of secondary refined 8,296 tons. Stocks of refined were well down at 93,446 tons, but those of blister were a little up at 21,473 tons.

[1] Recent prices, pp. 264, 304.

Tin.—The vindication of the experts who had for months been predicting a stronger tin market finally took place in April, when a somewhat erratic but none the less undeniable strength developed in tin. Prices move up fairly rapidly to a level in which three months metal at £850 per ton is the salient feature.[1] At this level there is a contango of £6 or £7 per ton.

When prices reached £830 per ton for the first time it was thought that Buffer Stock selling had been brought out and there was a brief interval before this level was reached again. Subsequently it began to be uncertain whether the market had been stopped by genuine intervention, but the next firm indication of Buffer Stock selling came at about £840, on a day when the market in London was all set to go to £860, following a spectacular jump in the price in Singapore. Since that date cash prices have not risen either far or sharply beyond £840 as demand on the Singapore market slowed down and prices there eased back again, although remaining well above parity with London—the ex-smelter price in fact being very close to the L.M.E. cash price.

There is no doubt that the behaviour of the market—and especially the fact that it shows so wide a backwardation—reflects speculative activity. With the world statistical position as tight as it is forward tin must be a good buy, but only a limited amount is available on the London market at any time. For the present, however, that amount seems to be sufficient.

Tin consumption in the U.K. in February was 1,760 tons, and production 1,977 tons of primary tin. Stocks, at 12,076 tons were higher.

Lead.—April has been characterized by a growing appreciation in market circles that the decision of the nations meeting at Mexico City to keep output to a level 2% below anticipated consumption was a more significant one than it was at first given credit for. Primarily this is so because the degree of accord between producers was greater than formerly and the decision arrived at was designed to produce a clear deficit—no matter how small—instead of merely a reduced surplus.

Although published news is scanty there is satisfaction that the arrangements for producers accumulated stocks to be taken up by the U.S. Government in barter are going forward. The better sentiment thus induced, however, is rather grudging in the face of the current statistical surplus and the improvement in prices has been commensurate.[1]

U.K. February consumption was 30,430 tons, production of English refined 6,666 tons, and stocks of refined dropped to 60,057 tons.

Zinc.—The better U.S. brass mill activity referred to in copper has been discernible in zinc too, although the U.S. zinc market needs a real boom in all departments to restore it to balance.[1] Action of another sort has, meanwhile, been taken by New Jersey Zinc Co., which cut ore and metal output—the latter by 1,500 tons a month, the former more drastically.

U.K. zinc consumption in February was 28,118 tons, so the showing this year has not been too good. Production was 6,622 tons and stocks dropped to 59,958 tons.

Iron and Steel.—By 1965 the British steel industry is expected to have an annual raw steel capacity of 32,000,000 ingot tons. This was predicted by the Iron and Steel Board in its third report on development in the iron and steel industry covering 1961–65. The Board believes that this ought to be sufficient to meet the requirements of a more rapid economic growth than there has been in recent years and will mean that British steelmakers will, for the first time for about two decades, be able to satisfy home consumers' steel needs with enough to spare to pursue a vigorous export policy.

Meanwhile the steel market is slowly improving as motor factories and allied works resume buying, although the recovery has been held back by many consumers running down their stocks. Until this process has been arrested—stronger rumours of a possible steel price rise could, in fact, reverse it—steel production is expected to remain below the high levels of last year.

While the sheet and strip mills could easily cope with more orders most plate and certain heavy-section mills, and rollers of reinforcing rounds, bars, and small sections are still very busy and delivery dates are fairly extended. Some heavy-section mills are finding that the flow of orders has dropped somewhat but have sufficient orders on their books to keep them busy for a few months.

One of steel's most important customers—shipbuilding—continues to cause a good deal of concern. Present consumption in the yards is on a fair scale, but the outlook appears very unpromising and the steel industry must reconcile itself to the fact that the days when it could count upon shipbuilders as being the largest consumer of plates may well be over.

Iron Ore.—Iron-ore production in the U.K. has been running at a high rate this year and in the first two months reached an average of 352,700 tons a week, as compared with 327,900

[1] See Table, p. 304.

[1] See Table, p. 304.

tons a week in the same period of 1960. Imports of iron ore and concentrates this year have been at a lower rate than last year, falling to 3,826,830 tons in the first quarter from 4,045,284 tons in the same quarter of 1960.

Aluminium.—While nobody expected miracles in any metal market in 1961 certain aspects of aluminium in the U.K. seem to be no better, and in fact a little worse, than some other aspects of the situation. With a domestic production of about 30,000 tons a year the U.K. is heavily dependent on imports of unwrought metal for its supplies, so that these form some sort of indicator of the level of activity of aluminium-using industries, although, of course, variations in the level of stocks held in this country have to be taken into account. Thus when viewing the very sharply reduced arrivals of unwrought aluminium into the U.K. in the first quarter of this year as compared with the same period of 1960 allowance must be made for the fact that the big ingot-supplying companies here—Canadian and American—had undoubtedly been doing some stock building in the latter part of last year, largely because their customers were doing the same thing at the same time. What is being seen now, therefore, is largely the unwinding of this process. At the same time the figures for U.K. aluminium consumption (as measured by sales of semis) are also down on the same period of 1960, although only by about 10%.

Antimony.—Over the past month the antimony metal and ore markets have been noticeably strong. The U.K. producers increased domestic prices for metal and, following the upward move, it was rumoured that the price of Chinese metal (of 99·6% grade) was taking a similar upward turn. Whether or not the price did rise is hard to prove, as no purchases at the higher price have been recorded. A rise such as was mooted would have brought Chinese prices, on a delivered basis, in line with those for U.K. metal. Current prices for 60% ore range from 26s. to 28s. per unit c.i.f., although outside the U.K. indications as high as 32s. have been heard ; 99% regulus is now £230 per ton and 99·6% at £237 10s. per ton.

Arsenic.—The general position of arsenic is still a fairly dull one as far as the metals field is concerned. The price of metallic arsenic in the U.K. is still held at £400 per ton and of arsenic trioxide at £40 to £45 per ton.

Bismuth.—Although day to day detail of the bismuth market is quite interesting, the general picture presented by this metal is one of outstanding stability and lack of new developments of interest. The U.K. price is still nominally 16s. per lb.

Cobalt.—Cobalt has remained quite a reasonable market in April, although the prospect is for a world surplus of this metal for a long time forward. Contract supplies of metal continue to change hands in the U.K. at 10s. 9d. per lb. and to others the price remains 12s.

Cadmium.—One of the periodic flurries in cadmium took place in April. Between a healthy demand and a somewhat reduced supply, due to curtailed zinc production and reduced flue-dust supplies, the U.S. market has got markedly stronger in recent months and was marked up by 10 cents per lb. early in April. It was contrary to some people's expectations that the market here did not follow suit, especially as the U.S.A. is, from time to time, the largest single source of cadmium in this market. However, consumption has not shown its traditional buoyancy this year—and in fact both colours and plating have shown reduced offtake. A rise has therefore been deferred while the position is studied, but few people take this to mean that it will be eliminated altogether. Current prices are 11s. per lb.

Chromium.—There was no change in chromium metal, prices of which are still indicated in the range 6s. 11d. to 7s. 4d. per lb.

Tantalum.—The market in tantalum ore has gone a little quieter in the past month, although the indications still are that something between 1,000s. and 1,200s. per unit is obtainable, c.i.f., for a good 60% ore.

Platinum.—There have been no new developments in platinum in April. The big producers continue to meet the contractual demands of their customers, but other business could be more plentiful. Their price remains £30 5s. per oz., while material from other sources is available at £27 10s. to £28 5s. per oz.

Iridium.—This is still one of the thinner platinum-metals markets and prices are quite unchanged at £20 to £26 5s. per troy oz.

Palladium.—Although a fair quantity of palladium is moving into consumption all the time, this is under long-term contracts. Day-to-day business is still very scanty and prices all round are unchanged in the range £8 10s. to £9 7s. 6d. per oz.

Osmium.—There has been no change in the position of this (from the market point of view) obscure metal. Prices remain £17 to £25 per oz.

Tellurium.—There continues quite a useful consumption of tellurium in lead and copper alloying, although for the present supplies are more or less adequate. Prices are unchanged at 28s. 6d. per lb. for lump and 40s. for sticks,

although for small quantities, at any rate of lump, a premium seems to obtain.

Tungsten.—Tungsten ore has remained extremely active in the past month. Scheelite has been more in demand than wolframite, which is most unusual in Europe. Owing to the termination of supplies from South Korea, which restarted at the very end of the month, the supply of scheelite has been very low. The present price range for wolframite is now 119s. to 124s. per unit after revision towards the end of the month ; it applies equally well to scheelite. Rumours were heard that contract shipments of Russian ore to Continental consumers were suffering interruption but these have been denied ; the Russians continued to offer ore in the U.K. in excess of their contractual obligations. As far as the U.K. has been concerned, too, consumers have been able to take material from Board of Trade stocks.

Nickel.—A much smaller addition to market supplies than the Canadian source reported last month appeared in April ; this was the Hanna Nickel Co. of Oregon, U.S.A., which has operated a plant there on domestic nickel ore for a number of years. Hitherto, however, production has gone to the U.S. stockpile but now it is being offered to the market. It remains to be seen what the actual level of sales is, but capacity is 11,000 short tons a year.

The world price remains at or about £600 per ton.

Chrome Ore.—A U.S. merchant firm got a certain amount of kudos in April for making what it expected to be the biggest ever shipment of chrome ore to the U.S.A. Otherwise the month was featureless ; for Rhodesian metallurgical ore the price indication is still £15 15s. per ton c.i.f.

Molybdenum.—Although the statistical indications have suggested that the high rate of molybdenum importation into Europe is sufficient for demand, inquiry for molybdenite continues to circulate in a number of directions. The crux of the matter is price and there is not much indication of premium-priced molybdenite finding a home. The current price is 8s. 11d. per lb. Mo, f.o.b. Climax, Colorado.

Manganese Ore.—In an otherwise dull month interest has been focused on reports that the state Government is making difficulties over renewing certain manganese ore concessions in India. Negotiations with the central Government are now proceeding, the outcome of which will be interesting to observe. Price indications are still largely nominal at 68d. to 71d.

Tin, Copper, Lead, and Zinc Prices

Tin, minimum 99·75% ; Copper, electro ; Lead, minimum 99·75% ; and Zinc, minimum 98%, per ton.

Date	Tin		Copper		Lead		Zinc	
	Settlement	3 Months	Spot	3 Months	Spot	3 Months	Spot	3 Months
	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
April 11	835 0	838 15	229 2½	230 2½	67 3¾	68 3¾	84 8¾	84 3¾
12	839 0	847 5	230 7½	231 7½	67 1¼	68 6¼	84 8¾	84 6¼
13	844 0	848 10	230 7½	231 17½	66 16¼	67 18¾	84 1¼	84 1¼
14	836 10	842 5	228 7½	229 17½	66 7½	67 17½	83 12½	83 13¾
17	835 10	840 15	227 17½	229 12½	65 16¼	67 7½	83 3¾	83 6¼
18	838 0	846 5	229 10	230 17½	66 13¾	67 18¾	83 18¾	83 18¾
19	839 0	847 15	229 2½	230 17½	67 3¾	68 16¼	83 16¼	83 18¾
20	843 0	850 15	228 7½	229 17½	67 3¾	68 3¾	83 12½	83 13¾
21	844 0	851 5	228 12½	230 7½	67 6¼	68 11¼	83 10	83 11¼
24	845 0	852 5	229 17½	231 12½	67 16¼	69 1¼	83 16¼	83 16¼
25	843 0	851 15	229 17½	231 12½	68 3¾	69 3¾	83 13¾	83 13¾
26	844 0	851 15	229 17½	231 17½	67 17½	68 18¾	83 13¾	83 13¾
27	842 0	848 10	232 7½	234 2½	67 18¾	69 1¼	83 17½	83 16¼
28	844 0	849 10	234 7½	235 12½	68 2½	69 2½	83 18¾	83 17½
May 1	843 10	849 5	234 7½	235 17½	67 11¼	68 13¾	83 12½	83 13¾
2	841 10	847 15	235 2½	236 12½	67 7½	68 11¼	83 11¼	83 11¼
3	842 0	848 10	235 17½	237 2½	66 12½	68 1¼	83 3¾	83 3¾
4	851 0	854 15	238 12½	239 17½	67 11¼	68 13¾	83 6¼	83 8¾
5	857 0	859 10	239 10	240 12½	67 11¼	68 16¼	83 8¾	83 8¾
8	861 0	861 5	241 7½	242 2½	67 16¼	69 1¼	83 1¼	83 1¼
9	862 0	865 15	243 7½	243 17½	68 6¼	69 6¼	83 6¼	83 6¼
10	862 0	865 15	241 17½	242 17½	67 13¾	68 18¾	83 0	83 3¾

Statistics

TRANSVAAL AND O.F.S. GOLD OUTPUTS

	March		April	
	Treated Tons	Yield Oz.†	Treated Tons	Yield Oz.*
Blyvooruitzicht	139,000	90,002	133,000	85,785
Brakpan	142,000	18,019	142,000	18,188
Buffelsfontein‡	150,000	66,028	150,000	15,923
City Deep	113,000	23,690	111,000	23,453
Cons. Main Reef	48,000	10,048	46,000	9,870
Crown Mines	193,000	33,326	176,000	30,546
Daggafontein	229,000	46,324	228,000	46,171
Dominion Reef	47,700	548	42,100	582
Doornfontein‡	115,000	47,530	115,000	48,317
D'rb'n Roodeport Deep	193,000	35,622	190,000	35,437
East Champ D'Or‡	12,500	291	12,000	260
East Daggafontein	108,000	18,460	108,000	18,474
East Geduld	130,000	37,050	125,000	35,625
East Rand P.M.	235,000	52,324	231,000	52,248
Eastern Transvaal Consol	19,000	5,711	20,000	5,603
Ellaton‡	25,000	5,862	24,000	5,607
Freddies Consol	64,000	13,529	65,000	13,110
Free State Geduld	97,000	84,747	98,000	85,601
Free State Saaiplaas	53,500	14,002	54,000	14,307
Geduld	80,000	12,406	75,000	12,364
Government G.M. Areas‡	42,000	9,244	38,000	8,718
Grootvlei Proprietary	215,000	44,537	212,000	43,896
Harmony Gold Mining	186,000	75,808	180,000	73,379
Hartebeestfontein‡	131,000	60,260	136,000	62,561
Libanon	117,000	28,542	118,000	28,781
Loraine	82,000	21,730	84,000	22,890
Luipaards Vlei‡	114,000	13,491	115,000	13,447
Marievale Consolidated	99,000	23,859	96,000	23,184
Modderfontein East	59,000	6,568	58,000	6,382
New Kleinfontein	75,000	10,324	72,000	10,134
New Klerksdorp‡	9,600	1,294	—	—
President Brand	123,000	96,533	124,000	97,341
President Steyn	108,000	40,533	110,000	41,200
Rand Leases	194,000	26,481	196,000	26,166
Randfontein‡	164,000	10,264	155,000	9,776
Rietfontein Consolid't'd.	12,000	3,276	12,000	3,257
Robinson Deep	42,500	9,643	43,500	9,651
Rose Deep	23,000	4,216	19,000	3,666
St. Helena Gold Mines	182,000	64,155	180,000	63,461
Simmer and Jack	69,000	12,728	69,000	12,701
S. African Land and Ex.	107,000	21,583	108,000	21,784
S. Roodepoort M.R.	29,000	6,955	29,000	7,029
Spaarwater Gold	11,200	3,580	11,200	3,726
Springs	94,000	12,967	94,000	12,890
Stilfontein Gold Mining‡	175,000	79,400	177,000	79,700
Sub Nigel	66,500	15,026	66,500	15,032
Transvaal G.M. Estates	—	—	—	—
Vaal Reefs‡	105,500	49,057	105,500	49,321
Van Dyk Consolidated	73,000	11,632	73,000	11,597
Venterspost Gold	125,000	36,263	125,000	36,421
Village Main Reef	35,600	4,110	36,200	4,181
Virginia O.F.S.‡	130,000	26,767	133,000	26,713
Vlakfontein	52,500	19,428	53,000	19,607
Vogelstruisbult‡	81,000	17,322	81,000	17,310
Welkom Gold Mining	99,000	31,410	99,000	32,001
West Driefontein‡	130,000	121,614	141,500	126,974
West Rand Consol.‡	218,000	22,396	213,000	22,650
Western Holdings	170,000	116,875	172,000	118,330
Western Reefs	150,000	43,501	154,000	44,900
Winkelhaak	94,000	31,961	93,000	31,621
Witwatersrand Nigel	19,900	4,272	20,000	4,270

† 250s. 3d. * 250s. 6d. ‡ Gold and Uranium.

COST AND PROFIT IN THE UNION *

	Tons milled	Yield per ton	Work'g cost per ton	Work'g profit per ton	Total working profit
		s. d.	s. d.	s. d.	£
Mar., 1960	17,464,400	72 8	46 5	26 3	30,105,571
April	—	—	—	—	—
May	—	—	—	—	—
June	17,968,300	73 9	46 3	27 6	31,941,743
July	—	—	—	—	—
August	—	—	—	—	—
Sept	18,103,100	74 0	46 4	27 8	32,201,685
Oct.	—	—	—	—	—
Nov.	—	—	—	—	—
Dec.	17,272,800	76 2	47 0	29 2	33,039,583
Jan., 1961	—	—	—	—	—
Feb.	—	—	—	—	—
Mar.	—	—	—	—	31,924,315

* 3 Months.

PRODUCTION OF GOLD IN SOUTH AFRICA

	Rand and O.F.S.	Outside	Total
	Oz.	Oz.	Oz.
April, 1960	1,734,310	36,720	1,771,030
May	1,765,880	37,897	1,803,777
June	1,775,335	37,530	1,812,865
July	1,776,141	39,673	1,815,814
August	1,778,711	36,777	1,815,488
September	1,774,967	35,352	1,810,319
October	1,777,495	35,967	1,813,462
November	1,775,624	36,159	1,811,783
December	1,744,406	34,044	1,778,450
January, 1961	1,785,614	34,407	1,820,021
February	1,759,373	32,046	1,791,419
March	1,837,280	38,843	1,876,123

NATIVES EMPLOYED IN THE SOUTH AFRICAN MINES

	Gold Mines	Coal Mines	Total
July 31, 1960	378,626	31,879	410,505
August 31	374,303	32,321	406,624
September 30	369,751	32,996	402,747
October 31	368,391	33,387	401,778
November 30	367,658	33,052	400,710
December 31	364,407	32,791	397,198
January 31, 1961	384,816	33,513	418,329
February 28	396,533	33,577	430,110
March, 31	398,626	33,736	432,362

MISCELLANEOUS METAL OUTPUTS

	4-Week Period		
	To April 1		
	Tons Ore	Lead Concs. tons	Zinc Concs. tons
Broken Hill South	23,400	3,783	4,182
Electrolytic Zinc	16,924	708	4,707
Lake George	13,501	913	1,815
Mount Isa Mines**	56,876	3,960†	5,343
New Broken Hill	48,160	4,886	12,731
North Broken Hill	24,852	4,975	5,312
Zinc Corp.	56,410	7,968	10,005
Rhodesia Broken Hill*	—	—	—

*3 Months, ** Copper 3,720 tons blister ; 7,807 tons concs. ; † Metal

RHODESIAN GOLD OUTPUTS

	March		April	
	Tons	Oz.	Tons	Oz.
Cam and Motor	—	—	—	—
Falcon Mines	22,500	4,384	22,500	4,399
Globe and Phœnix	4,920	3,052	3,690	3,013
Motapa Gold Mining	—	—	—	—
Mazoe	2,615	—	2,435	—
Coronation Syndicate	11,732	—	12,155	—
Phœnix Prince*	—	—	—	—

* 3 Months.

WEST AFRICAN GOLD OUTPUTS

	March		April	
	Tons	Oz.	Tons	Oz.
Amalgamated Banket	37,849	8,507	—	—
Ariston Gold Mines	35,500	11,421	—	—
Ashanti Goldfields	38,500	32,000	38,500	32,750
Bibiani	27,000	5,570	—	—
Bremang	—	4,954	—	—
Ghana Main Reef	11,607	4,388	—	—
Konongo	7,610	3,675	7,580	3,860
Lyndhurst	—	—	—	—

PRODUCTION OF GOLD AND SILVER IN RHODESIA

	1960		1961	
	Gold (oz.)	Silver (oz.)	Gold (oz.)	Silver (oz.)
January	44,902	29,711	47,673	22,101
February	45,754	29,865	—	—
March	45,309	29,656	—	—
April	48,607	6,847	—	—
May	47,542	62,912	—	—
June	45,884	34,298	—	—
July	44,865	33,323	—	—
August	48,284	28,931	—	—
September	48,865	38,951	—	—
October	47,473	37,308	—	—
November	46,439	33,896	—	—
December	48,778	26,327	—	—

WESTRALIAN GOLD PRODUCTION

	1959	1960	1961
	Oz.	Oz.	Oz.
January	63,924	64,794	62,434
February	65,035	66,789	73,271
March	65,408	61,941	69,360
April	62,686	65,373	—
May	64,184	66,682	—
June	74,590	74,902	—
July	78,974	67,623	—
August	68,546	67,466	—
September	66,501	68,794	—
October	70,427	67,310	—
November	68,858	107,815	—
December	117,474	76,269	—
Total	861,122	855,758	—

AUSTRALIAN GOLD OUTPUTS

	4-Week Period			
	To Mar. 28		To Apr. 25	
	Tons	Oz.	Tons	Oz.
Central Norseman	14,101	7,568	14,101	7,782
Gold Mines of Kalgoorlie	40,333	12,505	31,449	11,129
Gt. Boulder Gold Mines*	—	—	—	—
Gt. Western Consolidated	30,268	3,894	28,934	4,300
Lake View and Star*	167,397	38,710	—	—
North Kalgurli	43,453	10,189	—	—
Sons of Gwalia	11,266	2,289	—	—
Mount Morgan	—	3,428	—	—

* 3 Months.

ONTARIO GOLD AND SILVER OUTPUT

	Tons Milled	Gold Oz.	Silver Oz.	Value Canad'n $
November, 1959	770,437	227,176	35,262	7,600,949
December	775,803	221,377	40,807	7,388,654
January, 1960	778,103	226,856	27,617	7,550,068
February	755,569	222,484	35,003	7,446,848
March	804,309	229,457	37,202	7,646,044
April	779,487	218,393	42,997	7,426,262
May	784,391	225,550	32,174	7,765,153
June	791,488	223,833	49,765	7,756,490
July	779,426	222,179	37,002	7,664,968
August	712,792	202,025	35,722	6,883,254
September	772,984	208,019	29,251	7,114,785
October	805,753	228,914	33,808	7,860,787
November	785,133	230,377	31,149	7,917,352
December	783,501	229,639	37,560	8,020,961
January, 1961	804,026	227,771	28,776	7,901,743
February	737,859	214,763	33,291	7,465,046

MISCELLANEOUS GOLD AND SILVER OUTPUTS

	March		April	
	Tons	Oz.	Tons	Oz.
Clutha River	—	561	—	402
Lampa (Peru)†	—	26,786	—	40,824
New Guinea Goldfields	3,567	1,408	4,276	1,211
Yukon Consol.	—	—	—	—

† Oz. Silver: Copper, 91 tons; 133 tons.

AUSTRALIAN BASE-METAL OUTPUTS

Period	Concentrate Production (Long Tons)		
	Zinc	Copper (*a*)	Lead
1960	290,596	104,889	297,510
Provisional			
1961—January	15,070	7,945	15,540
February	—	—	—
March	—	—	—
April	—	—	—
May	—	—	—
June	—	—	—
July	—	—	—
August	—	—	—
September	—	—	—
October	—	—	—
November	—	—	—
December	—	—	—

(*a*) includes Cu content of direct smelting ore.

OUTPUTS OF MALAYAN TIN COMPANIES IN LONG TONS OF CONCENTRATES

	Feb.	Mar.	Apr.
Ampat Tin	33	35	47
Austral Amalgamated	—	—	—
Ayer Hitam	—	539*	—
Berjuntai	216½	258	269
Chenderiang	—	67½*	—
Gopeng Consolidated	—	455*	—
Hong Fatt (Sungei Besi)	—	—	—
Hongkong Tin	—	172*	—
Idris Hydraulic	—	115*	—
Ipoh	18	11½	—
Kampong Lanjut	92	99	119
Kamunting	107½	144	149
Kent (F.M.S.)	—	98*	—
Kepong	—	89*	—
Killinghall	—	48*	—
Kinta Kellas	16	13½	11
Kramat	48	44½	39
Kuala Kampar	137	131	137
Kuala Lumpur	—	—	—
Kuchai	—	—	—
Larut	19	30	28
Lower Perak	120	122½	98
Malayan	—	534*	—
Pacific Tin Consolidated	—	—	—
Pahang Consolidated	—	634*	—
Pengkalen	—	148*	—
Petaling Tin	—	396*	90
Rahman Hydraulic	—	—	38½
Rambutan	—	53*	—
Rantau	52½	59½	90
Renong	—	215½*	—
Selayang	—	3½*	—
Siamese Tin Syndicate (Malaya)	44	50	53
Southern Kinta	343	378	360
Southern Malayan	—	743*	—
Southern Tronoh	—	—	—
Sungei Besi	—	410½*	—
Sungei Kinta	—	—	—
Sungei Way	—	305*	—
Taiping Consolidated	—	—	—
Tanjong	—	193*	—
Tekka	—	—	—
Temoh	—	—	—
Tongkah Harbour	117	172½	206
Tronoh	—	851*	—

* 3 Months.

NIGERIAN MINE OUTPUTS (TONS)

	Jan.	Feb.
Cassiterite	866	858
Columbite	160	165
Felspar	—	—
Gold*	79	60
Kaolin	—	—
Lead Ore	8	—
Limestone	49,710	46,431
Monazite	1	1
Tantalite	1	1
Thorite	—	—
Wolfram	—	—
Zinc	—	—
Zircon	176	92

* Oz.

MISCELLANEOUS TIN COMPANIES' OUTPUTS IN LONG TONS OF CONCENTRATES

	Mar.		Apr.	
	Tin	Columbite	Tin	Columbite
Amalgamated Tin Mines	461	116	288	—
Anglo-Burma Tin*	—	—	—	—
Bangrin	43	—	35	—
Beralt	3	184†	3	163†
Bisichi	56	30	—	—
Ex-Lands Nigeria	40	—	45	—
Fabulosa	59	—	62	—
Geevor	56	—	54	—
Gold and Base Metal	67	3	—	—
Jantar Nigeria	19	30	—	—
Jos Tin	11	—	—	—
Kaduna Prospectors	6	—	7½	—
Kaduna Syndicate	22	—	30	—
Katu Tin	6	—	9	—
Keffi Tin	—	—	—	—
London Nigerian Mines	—	—	—	—
Mawchi Mines	—	—	—	—
Naraguta Extended	—	—	—	—
Naraguta Karama	5	—	—	—
Naraguta Tin	—	—	—	—
Ribon Valley (Nigeria)	—	—	—	—
Siamese Tin Syndicate	104	—	139	—
South Bukeru	—	—	—	—
South Crofty	78	—	65	—
Tavoy Tin	—	—	—	—
Tin Fields of Nigeria	—	—	—	—
United Tin Areas of Nigeria	17	½	—	—

* 3 Months. † Wolfram.

SOUTH AFRICAN MINERAL OUTPUT

January, 1961.

Gold	1,820,502 oz.
Silver	185,953 oz.
Diamonds	616,414 carats *
Coal	3,579,681 tons.
Copper	(a) — tons in matte and copper-gold concentrates. (b) 4,913 tons of 99·16%.
Tin	227 tons concs.
Platinum (concentrates, etc.)	—
Platinum (crude)	—
Asbestos	14,997 tons.
Chrome Ore	69,660 tons.
Manganese Ore	111,655 tons.
Lead Concs.	— tons.

* *December, 1960.*

IMPORTS OF ORES, METALS, ETC., INTO UNITED KINGDOM

		Feb.	Mar.
Iron Ore	tons	1,112,643	1,284,722
Manganese Ore	,,	43,296	49,367
Iron and Steel	,,	65,395	69,510
Iron Pyrites	,,	9,070	26,910
Copper Metal	,,	38,736	51,775
Tin Ore	,,	4,534	5,585
Tin Metal	,,	80	115
Lead	,,	11,266	23,186
Zinc Ore and Conc.	,,	2,527	16,397
Zinc	,,	11,217	16,561
Tungsten Ores	,,	499	859
Chrome Ore	,,	45,846	15,688
Bauxite	,,	39,247	30,990
Antimony Ore and Concs.	,,	1,151	1,710
Titanium Ore	,,	23,246	40,129
Zirconium Ores and Concs	,,	3,059	2,863
Tantalite/Columbite	,,	4	57
Sulphur	,,	39,369	45,398
Barytes	,,	5,706	2,074
Asbestos	,,	8,006	11,352
Magnesite	,,	9,904	16,380
Mica	,,	594	511
Graphite	,,	823	566
Mineral Phosphates	,,	110,761	131,743
Molybdenum Ore	,,	1,060	809
Silicon	,,	527	637
Nickel	cwt.	54,630	49,331
Aluminium	,,	464,644	365,595
Mercury	lb.	271,394	162,002
Bismuth	,,	81,816	14,952
Cadmium	,,	234,477	190,899
Cobalt and Cobalt Alloys	,,	360,859	495,366
Selenium	,,	24,671	35,425
Petroleum Crude	1,000 gal.	1,011,938	1,257,092

Prices of Chemicals

The figures given below represent the latest available.

		£	s.	d.
Acetic Acid, Glacial	per ton	104	0	0
,, ,, 80% Technical	,,	94	0	0
Alum, Comml.	,,	25	0	0
Aluminium Sulphate	,,	16	5	0
Ammonia, Anhydrous	per lb.		1	6
Ammonium Carbonate	per ton	59	0	0
,, Chloride,	,,	30	2	6
,, Nitrate	,,	36	5	0
Antimony Sulphide, golden	per lb.		4	4
Arsenic, White, 99/100%	per ton	47	10	0
Barium Carbonate 98–99%	,,	42	0	0
,, Chloride	,,	45	0	0
Barytes (Bleached)	,,	20	0	0
Benzene	per gal.		5	2
Bleaching Powder, 35% Cl.	per ton	30	7	6
Borax	,,	46	10	0
Boric Acid, Comml.	,,	77	10	0
Calcium Carbide	,,	40	17	9
,, Chloride, solid, 70/75%	,,	17	0	0
Carbolic Acid, crystals	per lb.		1	3
Carbon Bisulphide	per ton	62	10	0
Chromic Acid (ton lots)	per lb.		2	2¼
Citric Acid	per cwt.	9	17	0
Copper Sulphate	per ton	77	0	0
Creosote Oil (f.o.r. in Bulk)	per gal.		1	2
Cresylic Acid, refined	,,		7	10
Hydrochloric Acid 28° Tw.	per carboy		13	6
Hydrofluoric Acid, 59/60%	per lb.		1	1
Iodine	per kilo		17	4
Iron Sulphate	per ton	3	5	0
Lead, Carbonate, white	,,	112	5	0
,, Nitrate	,,	110	0	0
,, Oxide, Litharge	,,	101	5	0
,, Red	,,	99	5	0
Lime Acetate, brown	,,	40	0	0
Lithopone	,,	57	10	0
Magnesite, Calcined	,,	20	0	0
,, Raw	,,	13	0	0
Magnesium Chloride	,,	20	0	0
,, Sulphate, Comml.	,,	15	10	0
Methylated Spirit, Industrial, 66 O.P.	per gal.		6	1
Nickel Sulphate	per ton	189	0	0
Nitric Acid, 70° Tw.	,,	35	0	0
Oxalic Acid	,,	132	0	0
Phosphoric Acid (S.G. 1·750)	per lb.		1	4
Potassium Bichromate	,,		1	2½
,, Bromide	,,		2	6
,, Carbonate (hydrated)	per ton	72	10	0
,, Chloride	,,	21	0	0
,, Iodide	per kilo		19	3
,, Hydrate (Caustic) solid	per ton	92	0	0
,, Nitrate	per cwt.	3	10	0
,, Permanganate	per ton	198	0	0
,, Sulphate, 50%	,,	21	1	0
Sodium Acetate	,,	63	0	0
,, Arsenate, 58–60%	,,	Nominal		
,, Bicarbonate	,,	18	0	0
,, Bichromate	per lb.		1	0
,, Carbonate (Soda Ash) 58%	,,	16	0	0
,, Chlorate	per ton	90	0	0
,, Cyanide	per cwt.	6	18	10
,, Hydrate, 76/77%, solid	per ton	33	0	0
,, Hyposulphite, Comml.	,,	35	0	0
,, Nitrate, Comml.	,,	Nominal		
,, Phosphate (Dibasic)	,,	40	10	0
,, Prussiate	per lb.		1	0½
,, Silicate	per ton	11	10	0
,, Sulphate (Glauber's Salt)	,,	12	5	0
,, ,, (Salt-Cake)	,,	10	0	0
,, Sulphide, flakes, 60/62%	,,	38	12	6
,, Sulphite, Comml.	,,	27	15	0
Sulphur, American, Rock (Truckload)	,,	13	0	0
,, Ground, Crude	,,	17	10	0
Sulphuric Acid, 168° Tw.	,,	12	0	0
,, ,, free from Arsenic, 140° Tw.	,,	8	10	0
Superphosphate of Lime, 18% P_2O_5	,,	13	15	0
Tin Oxide	,,	Nominal		
Titanium Oxide, Rutile	,,	172	0	0
,, White, 25%	,,	85	0	0
Zinc Chloride	,,	95	0	0
,, Dust, 95/97% (4-ton lots)	,,	125	0	0
,, Oxide	,,	97	10	0
,, Sulphate		32	0	0

Share Quotations

Shares of £1 par value except where otherwise stated.

GOLD AND SILVER :

	Apr. 10, 1961 £	s.	d.	May 9, 1961 £	s.	d.
SOUTH AFRICA :						
Blinkpoort (5s.)	1	19	6	1	18	9
Blyvooruitzicht (2s. 6d.)	1	3	6	1	3	6
Bracken (10s.)		19	6		17	3
Brakpan (3d.)		3	3		3	3
Buffelsfontein (10s.)	1	12	6	1	11	6
City Deep		12	3		12	0
Consolidated Main Reef		12	6		12	6
Crown Mines (10s.)		19	6		19	3
Daggafontein (5s.)		18	6		16	9
Dominion Reefs (5s.)		18	0		17	6
Doornfontein (10s.)	1	3	0	1	3	3
Durban Roodepoort Deep (10s.)	1	3	6	1	0	3
East Champ d'Or (2s. 6d.)		1	6		1	9
East Daggafontein (10s.)		7	6		7	6
East Geduld (4s.)		16	0		15	3
East Rand Ext. (5s.)		14	3		13	0
East Rand Proprietary (10s.)	1	5	0	1	5	3
Freddies Consol.		1	0		1	0
Free State Dev. (5s.)		3	9		3	3
Free State Geduld (5s.)	4	7	6	4	2	0
Free State Saaiplaas (10s.)		5	6		5	0
Geduld	1	18	9	1	16	3
Government Gold Mining Areas (3d.)		2	0		2	0
Grootvlei (5s.)		15	0		14	6
Harmony (5s.)	1	2	6		19	6
Hartebeestfontein (10s.)	2	3	9	1	17	6
Libanon (10s.)		10	0		10	9
Loraine (10s.)		16	3		14	0
Luipaards Vlei (2s.)		7	6		7	6
Marievale (10s.)	1	3	0	1	1	3
Modderfontein B (3d.)		1	6		1	6
Modderfontein East		9	0		8	6
New Kleinfontein		3	6		3	9
New Pioneer (5s.)	1	5	0	1	1	3
New State Areas (15s. 6d.)			6			6
President Brand (5s.)	2	6	3	2	3	6
President Steyn (5s.)		15	9		15	9
Rand Leases (9s. 3d.)		4	3		3	9
Randfontein		18	0		16	6
Rietfontein (3d.)		2	6		2	9
Robinson Deep (5s. 6d.)		3	6		4	3
Rose Deep (3d.)		5	6		5	0
St. Helena (10s.)	2	12	3	2	8	9
Simmer and Jack (1s. 6d.)		1	0			9
South African Land (3s. 6d.)		13	9		11	9
Springs (3d.)		1	0		1	0
Stilfontein (5s.)	1	7	6	1	6	6
Sub Nigel (3d.)		7	3		6	9
Vaal Reefs (5s.)	1	13	9	1	10	0
Van Dyk (3d.)		2	3		2	3
Venterspost (10s.)		15	6		16	3
Virginia (5s.)		3	0		2	9
Vlakfontein (10s.)		14	0		14	0
Vogelstruisbult (3d.)		4	0		4	0
Welkom (5s.)		12	3		11	9
West Driefontein (10s.)	3	12	6	3	9	0
West Rand Consolidated (10s.)		16	9		15	6
West Witwatersrand Areas (2s. 6d.)	2	8	9	2	5	3
Western Holdings (5s.)	5	13	9	5	4	0
Western Reefs (5s.)	1	3	0	1	1	3
Winkelhaak (10s.)		18	0		15	9
Witwatersrand Nigel (2s. 6d.)			9			9
Zandpan (10s.)		9	0		6	6
RHODESIA :						
Cam and Motor (2s. 6d.)		—			—	
Chicago-Gaika (10s.)		13	9		13	9
Coronation (2s. 6d.)		4	6		3	9
Falcon (5s.)		7	9		7	3
Globe and Phœnix (5s.)	1	13	0	1	7	6
Motapa (5s.)		—			—	
GHANA :						
Amalgamated Banket (3s.)			9		—	
Ariston Gold (3s. 6d.)		3	9		—	
Ashanti Goldfields (4s.)		13	6		12	9
Bibiani (4s.)		3	9		—	
Bremang Gold Dredging (5s.)		3	6		—	
Ghana Main Reef (5s.)		2	9		—	
Konongo (2s.)		1	0		1	0
Kwahu (2s.)		4	6		4	3
Offin River (2s. 6d.)		2	0		2	0
Western Selection (5s.)		4	9		4	9
AUSTRALASIA :						
Gold Fields Aust Dev. (3s.), W.A.		1	6		1	3
Gold Mines of Kalgoorlie (10s.)		7	6		8	0
Great Boulder Propriet'y (2s.), W.A.		12	3		12	0
Lake View and Star (4s.), W.A.	1	4	9	1	3	6
Mount Morgan (10s.), Q.		12	0		12	0
New Guinea Gold (4s. 3d.)		1	3		1	3
North Kalgurli (1912) (2s.), W.A.		9	9		10	0
Sons of Gwalia (10s.), W.A.		3	0		3	0
Western Mining (5s.), W.A.		10	0		11	9

	Apr. 10, 1961 £	s.	d.	May 9, 1961 £	s.	d.
MISCELLANEOUS :						
Fresnillo ($1·00)	1	6	3	1	10	0
Kentan Gold Areas		19	3		18	3
St. John d'el Rey, Brazil	5	15	0	4	17	6
Yukon Consolidated ($1)		3	10½		3	9
COPPER :						
Bancroft Mines (5s.), N. Rhodesia		13	6		13	6
Esperanza (2s. 6d.), Cyprus		1	3		1	3
Indian (2s.)		6	0		6	0
MTD (Mangula) (5s.)		7	0		6	6
Messina (5s.), Transvaal		14	9		13	6
Mount Lyell (5s.), Tasmania		4	9		4	9
Nchanga Consolidated, N. Rhodesia	2	6	0	2	9	3
Rhokana Corporation, N. Rhodesia	2	2	0	2	5	6
Roan Antelope (5s.), N. Rhodesia		5	3		5	6
Tanganyika Concessions (10s.)	1	6	6	1	3	3
LEAD-ZINC :						
Broken Hill South (1s.), N.S.W.		9	3		9	0
Burma Mines (3s. 6d.)		1	0		1	0
Consol. Zinc Corp. Ord.	3	16	0	3	13	0
Lake George (5s.), N.S.W.		5	6		3	6
Mount Isa, Queensland (5s. Aust.)	2	7	0	2	10	0
New Broken Hill (5s.), N.S.W.	2	2	0	2	7	0
North Broken Hill (10s.), N.S.W.		14	0		15	0
Rhodesia Broken Hill (5s.)		6	9		6	6
San Francisco (10s.), Mexico		14	0		14	3
TIN :						
Amalgamated Tin (5s.), Nigeria		11	0		12	6
Ampat (4s.), Malaya		14	3		15	6
Ayer Hitam (5s.), Malaya	1	16	6	2	1	3
Beralt (5s.), Portugal	1	7	3	1	6	9
Bisichi (2s. 6d.), Nigeria		5	6		5	3
Ex-Lands (2s.), Nigeria		3	6		4	3
Geevor (5s.), Cornwall	1	1	3	1	3	0
Gold Base Metals (2s. 6d.), Nigeria		2	0		2	3
Hongkong (5s.), Malaya	1	5	0	1	5	0
Jantar Nigeria (3s.)		5	6		6	3
Kaduna Syndicate (2s.), Nigeria		2	3		2	9
Kamunting (5s.), Malaya		17	0	1	2	6
Malayan Tin Dredging (5s.)	1	10	6	1	15	6
Mawchi Mines (4s.), Burma		1	3		1	3
Naraguta Karama (5s.), Nigeria		1	3		1	3
Pahang (5s), Malaya		12	3		17	6
Siamese Synd. (5s.)		16	6	1	0	0
South Crofty (5s.), Cornwall		4	0		4	2
Southern Kinta (5s.), Malaya	1	13	6	1	14	3
Southern Malayan (5s.)	1	14	0	1	14	9
Sungei Besi (4s.), Malaya	1	13	9	2	3	6
Sungei Kinta, Malaya		18	3		18	6
Sungei Way (2s. 4d.), Malaya		4	9		5	3
Temoh (7s. 6d.), Malaya		4	3		5	3
Tronoh (5s.), Malaya	2	6	6	3	2	6
United Tin Areas (2s. 6d.), Nigeria		1	3		2	1½
DIAMONDS :						
Anglo American Investment	10	12	6	8	15	0
Consol African Selection Trust (5s.)		14	3		14	9
Consolidated of S.W.A. Pref. (10s.)		9	6		9	0
De Beers Deferred (5s.)	6	4	3	·5	14	3
FINANCE, Etc.						
African & European (10s.)	2	18	9	2	17	6
Anglo American Corporation (10s.)	6	5	0	5	17	6
Anglo Transvaal 'A' (5s.)	1	8	6	1	5	6
British South Africa (15s.)	3	1	9	3	1	0
British Tin Investment (10s.)	2	3	9	2	6	3
Broken Hill Proprietary	2	16	6	3	0	6
Camp Bird (10s.)		6	6		6	0
Central Mining	1	6	3	1	9	6
Central Provinces Manganese (10s.)	1	4	9	1	2	6
Consolidated Gold Fields	2	6	6	2	10	3
Consolidated Mines Selection (10s.)	1	2	9	1	2	3
Corner House		8	3		10	0
East Rand Consolidated (5s.)		1	9		1	9
Free State Development (5s.)		3	9		3	3
General Exploration O.F.S. (2s. 6d.)		2	9		2	9
General Mining and Finance	4	7	6	4	0	0
Hendersons (4s.)		6	6		6	6
Johannesburg Consolidated	1	19	3	1	19	9
London & Rhod. M. & L. (5s.)		4	3		4	0
London Tin Corporation (4s.)		16	0		17	9
Lydenburg Est. (5s.)		9	6		5	6
Marsman Investments (10s.)		2	7½		2	7½
National Mining		2	0		2	0
Rand Mines (5s.)	3	6	3	3	7	6
Rand Selection (5s.)	1	12	6	1	10	6
Rhodesian Anglo American (10s.)	2	15	3	2	18	0
Rhodesian Corporation (5s.)		2	0		1	9
Rhodesian Selection Trust (5s.)		10	3		10	3
Rio Tinto (10s.)	2	1	9	2	0	0
Selection Trust (10s.)	4	7	6	4	0	0
South West Africa Co. (3s. 4d.)		10	0		10	0
Union Corporation (2s. 6d.)	2	2	9	2	1	3
Vereeniging	4	5	0	4	0	0
West Rand Inv. Trust (10s.)	2	0	0	1	17	6

THE MINING DIGEST

A RECORD OF PROGRESS IN MINING, METALLURGY, AND GEOLOGY

In this section abstracts of important articles and papers appearing in technical journals and proceedings of societies are given, together with brief records of other articles and papers; also notices of new books and pamphlets and lists of patents on mining and metallurgical subjects.

Hydraulic Transport of Phosphate Matrix

A number of articles in *Mining Engineering* for March covers the " Hydraulic Transportation of Florida Phosphate Matrix." The following notes are taken from an introductory essay by H. B. Hardy and S. A. Canariis, who say that pebble-bearing matrix in the Florida field has physical properties which make it readily adaptable to methods employing solids-handling pumps and pipelines. The abundance of water available, a practically flat terrain, low costs per ton-mile, and beneficiation of the matrix by agitation while being pumped have contributed to the popular choice of hydraulic transport.

Phosphate pebble mining in Florida, begun in the 1860's, first, they say, used high-pressure water and solids-handling pumps for overburden removal about 1900. Removal of the average 25 ft. of overburden was followed by hydraulic mining of the matrix, with 6-in. and 8-in. pumps handling 50 to 100 cu. yd. per hour being moved along the floor of the pit as they were advanced toward the face being undercut and slurried by hydraulic guns.

In the 1920's draglines were introduced to strip overburden and, about 1935, began to be employed also to dig the matrix; with this operation the matrix was dumped in a sump at ground level, where it was slurried and pumped to the recovery plant. Demand for more production and availability of heavier equipment to move larger pumps had caused a gradual increase to 12-in. pumps and 14-in. pipe through the early 1940's and, by 1950, to 14-in. or 16-in. pumps and 16-in. pipe. The largest pipe being used at present in matrix pumping service is 20-in. I.D. pipeline length has increased to more than 5 miles in some cases since it has proved more economical to transport the matrix over such distances than to construct new recovery plants closer to the mine location.

The composition of the Florida matrix varies widely in percentages of pebble, flotation feed, slimes (everything finer than 150 mesh) and silica tailings, and in the character of these components. Thus the mining cost and pumping costs, it is pointed out, also vary widely. In general, to produce 1 ton of shipping grade rock it is necessary to remove 6 to 8 tons of overburden, pump 3 tons of matrix to the recovery plant, and to dispose of 2 tons of sand tailings and clay slimes as waste.

The character of the matrix affects the density of the slurry that can be supplied to the pump at the sump or " pit " and also the friction loss that must be overcome in the pipeline. It is found that the per cent. solids by weight of matrix in the usual slurry may range from 25% to 45%. Using a specific gravity of 2·7 for dry rock and 1·282 for the slurry (35% solids by weight), 8,000 g.p.m. of slurry would carry about 700 cu. yd. per hour of matrix as mixed. This amounts to 778 long tons per hour of dry matrix for a typical condition where matrix as mined contains 20% moisture by weight and weighs 120 lb. per cu. ft. as mined.

Allowing a TDH per pump of 150 ft. and using a friction loss of 30 ft. per 1,000 ft. of 16-in. I.D. pipe (Williams and Hazen C = 130), the pit pump and relay stations operating from sumps could handle 4,300 ft. of pipe, while series-connected booster or " lift " pumps could handle 5,000 ft. With a pump efficiency of 70%, 555 b.h.p. would be required per unit. Thus a system utilizing a pit pump and two booster pumps would require 1,665 b.h.p. to pump through 14,300 ft. of pipe (assuming no static head) and for continuous pumping at an average slurry density of 1·282, there would be a requirement of 0·67 kWh per ton-mile (using a motor efficiency overall of 85%). This example illustrates one of many possible situations involving different slurry densities, pipe friction losses, static head changes, and production requirements.

The three other articles point out differences in mining and pumping operations by three different companies engaged in phosphate

mining. Obviously the different methods of control will result in different operating costs and maintenance costs, making an average cost figure difficult to find. In general, the cost of maintenance of the pumping units averages \$1·50 per hour and the cost of replacing pipe after 6,000,000 tons of matrix have been pumped averages \$·0077 per ton-mile. Operators for the pumping and gunning operations will average \$·0068 per ton-mile. Supplying the gun water at the pit to be used in making up the slurry at 150–200 p.s.i. is another direct cost of hydraulic transportation of the matrix. This requires approximately 1 b.h.p. per long ton of matrix.

The table following summarizes some direct costs per ton-mile based on the situation described above, where three pumps are used in a pipeline 2·81 miles long :—

	\$
(1) Pumping cost, at 1·1 cents per kWh	0·0074
(2) Pumping cost, hydraulic gun water	0·0034
(3) Cost of hourly employees, operators	0·0068
(4) Cost of pipeline replacement . .	0·0077
(5) Cost of pumping unit maintenance at \$1·50 per hour per unit . .	0·0023
(6) Interest on investment . . .	0·0020

No costs of electrical transmission or of obtaining "rights-of-way" for pipelines or electrical line are included, nor are overhead costs such as insurance and supervision. With improvements in pipeline operation and lowering of maintenance and labour costs expected with increased use of automation, the future will, it is suggested, probably find pipelines becoming longer and capacities greater.

Mineral Potentialities of the Bitterfontein Area, Cape Province

A recent South African Geological Survey publication [1] provides an explanation of Survey Sheet 253, which covers parts of the Vanrhynsdorp and Namaqualand district of the Cape Province, South Africa. In an abstract to the report it is stated that physiographically the area consists of a flat to slightly undulating sandy coastal belt and of hilly country in its northern and eastern portions, which attains a maximum height of approximately 1,900 ft. above sea-level.

A complex of gneissic and metamorphic rocks occupies by far the greater part of the area. Granitization, mainly of the synkinematic type and leading to local mobilisation of its products, occurred on a large scale. The pink gneiss, which is considered to represent highly granitized Malmesbury sediments, is subdivided into aplogneiss or aplogranulite, pink biotite gneiss, biotite augen-gneiss or flaser-gneiss, and muscovite gneiss. The pink gneiss and metamorphosed Malmesbury sediments originated during the first cycle of metamorphism and metasomatism which was followed almost immediately by a second cycle—*i.e.*, by static granitization and extensive migmatization characterized by the growth of large feldspar porphyroblasts. The constituent rocks are porphyroblastic granite, syenite, granodiorite, and diorite, which are in some places gneissic. The areas affected by metasomatism cut across all pre-existing structures.

A period of intrusive activity subsequent to the two cycles of metamorphism and metasomatism commenced with the emplacement of a small intrusion of hornblende gabbro and of numerous dykes and occasionally pipes or plugs of lamprophyric and associated rocks such as minette, kersantite, camptonite, augite diabase, monchiquite, hybrid rocks, and intrusive breccias. Contemporaneously and subsequently were emplaced the following intrusive bodies : An intrusion composed of larvikite, monzonite, and syntectic granite, small bosses of umptekite with aureoles of fenite, and numerous dykes of bostonitic rocks—such as, bostonite, gauteite, sölvsbergite, microsyenite, and intrusive breccias. Finally numerous dykes of quartz porphyry and associated alkaline granite-porphyry and granophyre were emplaced. The magmatic cycle was concluded by the emplacement of large granite plutons. Polymetamorphic rocks which were originally Malmesbury sediments are represented by katazonal contact-metamorphic rocks and also by certain types of hornfels grading into mylonitic rocks which most likely originated by alternative phases of cataclastic deformation and recrystallization during the second cycle of metamorphism and the ensuing magmatic cycle.

The Nama System, which unconformably overlies the gneissic and metamorphic rocks, is represented by the Kuibis and Schwarzkalk Series.

[1] JANSEN, H. "The Geology of the Bitterfontein Area, Cape Province : An Explanation of Sheet 253 (Bitterfontein)." Pretoria : Government Printer. Price 10s., with map.

Younger intrusive rocks are represented by dolerite dykes, probably of Post-Karoo age and by two small pipes of melilite basalt, probably of Post-Lower Cretaceous age.

Tertiary and Quaternary deposits cover a large portion of the area, in particular along the coast.

The disposition and correlation of the structures displayed by the Malmesbury Formation and the complex of gneissic and metamorphic rocks are partly obscured by local mobilization of the gneissic rocks and by the possible influence of Pre-Malmesbury formations of the lower crust on the tectonics and granitization of the upper crust.

Post-Nama block faulting occurred on a large scale, especially in the eastern portion of the area. The faults or fault-zones strike approximately south-east. Branch faults, parallel faults, and an *en échelon* disposition of the faults are common. The fault planes are frequently filled by large quartz veins. The fault blocks as a rule are tilted to the south and occasionally grade into monoclinal or anticlinal structures.

The mineral resources of the area, which are being exploited, mainly on a small scale, are diamonds, marble, kaolin, gypsum, and salt. Of potential economic interest are the ilmenite sands along the coast, the occurrences of iron and manganese oxides in the south-eastern part of the area, and perhaps also kaolin, marble, and limestone. Prospecting for monazite and kyanite might reveal deposits of economic importance. The lignite deposits may be of economic interest in the far future.

(*To be concluded*)

Foam Used to Fight Coal-Mine Fire

Information Circular 8019 of the United States Bureau of Mines, by T. J. McDonald, describes the " Use of High-Expansion Foam on a Pennsylvania Coal Mine Fire." The circular states that the Bureau of Mines began investigating the foam-plug technique in 1957 in its experimental coal mine, following reports of successful trials in England, where the basic methods, using the normal ventilating current, were developed. Early in the research, however, it was apparent that the normal ventilating current in mines in the United States would not provide adequate air pressure to drive a foam plug the distance that might be required. Subsequently the Bureau developed a portable high-expansion foam generating unit consisting of a fan having relatively high pressure potential net, sprays, and metering equipment. To date foam generators have been constructed by the Bureau, by at least one operating coal company, and by one manufacturer of safety equipment. A number of units from the latter supplier have been adopted by coal-mining companies as an integral part in their firefighting installations.

The equipment used in the operating mine includes a flexible duct between the fan and the net frame to conduct air from the fan to the net. Spray nozzles are mounted on the net frame and the entire net is maintained wet during operation. Water and the foaming agent are mixed at the pump and the solution is conducted to the sprays through the hose. When the foam generator is used underground the net is sealed in the entry to prevent air leakage around the net.

At the mine concerned the fire started about 11.30 a.m. on June 10, 1960, in the vicinity of an automatic car spotter near the discharge end of a coal conveyor-belt. The cause of the fire has not been determined, but it originated in a so-called neutral air zone—that is, the area was air locked and only enough air was permitted to course through the area to prevent accumulations of noxious and combustible gases within the air lock. This delayed firefighting operations because there was not enough air movement to remove smoke and firefighters were prevented from approaching the fire.

There were nine men in the section inby the fire area and the first concern of all parties was for the safe evacuation of these men. Naturally, if the air lock was opened, smoke and fumes from the fire would move and permit firefighting operations to begin immediately. This procedure would very likely permit the products of combustion to be coursed over the workmen ; therefore, the workmen were led to safe areas before the air lock was opened. This was accomplished in approximately an hour after the fire started. After the men were evacuated efforts were made to open the air lock in order to move the smoke from the fire area, but by this time the air lock could be approached only by men wearing self-contained oxygen breathing apparatus. The air lock was opened at about 3.05 p.m. Before the air lock was opened a man

door in a stopping between the intake and return airways, about 150 ft. inby the fire, was opened from the return side. Efforts were made to drive the smoke back with water discharged through a fog nozzle. This was somewhat effective but not enough to permit the fire to be attacked directly.

Water was used to fight the fire until about 9.10 p.m., at which time the foam generator was started.

The fire had reached very serious proportions before the foam generator was used. It had spread over a large area, massive roof falls were occurring, and the concentrations of combustible gases were approaching the lower explosive limit in the return airway on the outby side of the fire. Investigators believed that no more combustible gases would be formed when high-expansion foam was applied to a mine fire than when the equivalent amount of water was applied in the conventional manner. In this instance less combustible gases were formed by the foam and if this had not happened it would have been necessary to remove all persons from the mine for safety reasons.

When foam was applied constant checks were made to determine the combustible gas content in the air from the fire area. As foam reached the fire the concentration of combustible gases decreased and was reduced to a safer percentage. The men who were checking the atmosphere were of the opinion that this was the turning point in the firefighting operations—that the atmosphere in the fire area now could be controlled within reasonable limits and, therefore, the potential explosion hazard could be kept to a minimum. This method permitted firefighting operations to be continued, whereas without some control of the atmosphere the firefighters would have been forced, for reasons of safety, to abandon the fire.

Inasmuch as this was the first time high-expansion foam was used extensively on a mine fire there was some anxiety on the part of most of the officials regarding the performance of the foam. In order to determine the effect of the foam on the fire the foam generator was stopped periodically and water was again applied directly to the fire. During one of the periods when the generator was stopped the fire was discovered spreading towards a pillared area. Just as the build-up of combustible gases in the earlier stages presented a crisis, another crisis was presented by the fire approaching the pillared area. If the fire reached the pillared area control or extinguishing would be impossible without sealing a very large portion of the mine and possibly the entire mine. For this reason the foam generator was quickly moved toward the pillared area, and foam was started. This action was successful to the extent that the progress of the fire toward the pillared area was stopped. To prevent any further threat seals were erected between the pillared area and the fire area.

As previously mentioned, a man door was opened on the return air side of the fire area in an effort to provide an air current to move the smoke which permitted direct attack on the fire. Opening the door was a logical and necessary action in the early stages of the firefighting operations ; however, after the fire had spread to such a large area the open door provided a direct path for the fire to enter a mined-out area. In an effort to stop the fire's progress toward the open door the foam generator was again moved and foam was forced toward the door. At this point it was decided to operate the foam generator intermittently and to continue with erecting seals to prevent the fire's progress in the direction of the mined-out area. When sealing operations progressed to the stopping with the open man door it was discovered that the man door had practically been consumed by fire. Evidence indicated that the foam was successful in extinguishing the fire in the vicinity of the man door, thereby preventing the fire from reaching the mined-out area. Inasmuch as fire seals were installed on two sides of the fire it was decided to continue sealing operations and at the same time operate the foam generator in order to reduce the heat in the fire area and prevent a build-up of combustible gases. This operation was continued intermittently until the fire was completely sealed.

Large roof falls had occurred in the fire area and some of these falls were believed to be so tight that air could not be forced over them. Therefore it was not possible to completely engulf the falls with high-expansion foam. Although the use of high-expansion foam on this fire provided much knowledge that should be useful in the future it did not provide any definite information as to the effectiveness of foam on burning material under massive roof falls.

Several times during sealing operations, while the foam generator was in operation, smoke and the products of combustion were forced from the area by the high air pressure through broken strata, as a result of falls and roof-bolt holes. Because experience with the foam generator was limited before the fire this condition was not anticipated. However, through the use of hindsight, this condition might be expected

when foam is forced into a fire area where massive roof falls have occurred. When it is considered that the normal ventilating pressure in a section of a mine is not more than $\frac{1}{2}$ in. water gauge, and that the fan used on a high-expansion foam generator operates at from 5 in. to 10 in. of water gauge, air and gases can be expected to escape through open strata above the coal and through stoppings of standard construction.

The forcing of the products of combustion through roof-bolt holes and open strata, as a result of roof falls, could in some instances endanger the lives of firefighters. Lives were not endangered in this instance because the atmosphere in which men were working was constantly being checked and the foam generator was equipped with a dampering device that permitted fan pressure to be reduced when necessary.

The following conclusions are drawn as a result of the performance of high-expansion foam plug on this particular fire :—

(1) Air entering a fire area must be coursed through the net where the foam is generated ; air leakage around the net decreases the foam velocity and provides unwanted air.

(2) A foam generator may be moved to control the leading edges of the fire that may be endangering a particular area.

(3) Less-combustible gases are formed by the application of high-expansion foam on a mine fire than normally would be formed by the application of water.

(4) The effectiveness of foam on deep-seated fires under massive fallen material was not established at this fire and is not known at this time.

(5) The atmosphere in which men work must be checked constantly while a foam generator is in operation.

(6) Men who are expected to apply foam to a mine fire must be trained in the proper technique.

(7) The application of foam prevented the necessity of sealing a very large portion of the mine and possibly the entire mine. This occurred at three stages : (*a*) When the percentage of combustible gases was reduced, thereby permitting firefighters to remain in the mine ; (*b*) when the foam stopped the progress of the fire toward a pillared area, and (*c*) when the progress of the fire was controlled after burning an open man door that was adjacent to a mined-out area.

(8) A foam plug is not a cure-all for controlling mine fires, neither should it be considered a last resort method of fighting a fire. A high-expansion foam generating unit is not a substitute for any standard firefighting equipment, but is supplemental thereto.

Automatic Plant Control

In an article appearing in the *Canadian Mining Journal* for March, J. R. Riede and G. C. Kachel discuss " Instrumentation and Automatic Control Systems in Modern Processing Plants." They suggest that the evolution of instrumentation and automatic control in mineral dressing processes has followed a natural and logical sequence of measurement, then recording, of the measured process variables, and finally full automatic control of many portions of the process. While some of the measuring devices and control systems described in the article find particular application in the processing of low-grade iron ores, most of the measurement and control philosophies can be extended to the processing of other minerals.

The authors go on then to review the various measurements that can be taken and to review both pneumatic and electrical instrumentation in brief. They then say that while the measurement and recording of process variables can be valuable aids to the operator in manual control of process, economies in direct labour and significant improvements in product quality can often be accomplished through automatic control of many portions of the mineral dressing process. In a typical process and equipment flow-sheet for the processing of a magnetic taconite product many of the control systems with minor changes in sensing elements, could be equally adaptable to the processing of other minerals. A brief description of some of these systems follows.

Some magnetic taconite plants have continuous and integrating assay computing systems installed on their coarse-ore conveyors. These devices compute and record the magnetic assay of the ore from each truck or train and, once each eight hours, record the average assay of the ore that has been crushed during that eight-hour interval. With this system it is possible to read production in terms of " x " number of tons of " y " per cent. magnetic ore per eight-hour shift.

A system, adaptable to some types of gyratory

crushers, provides a continuous indication and record of the vertical height of the mantle. With this system the operator may lower or raise the mantle to free a rolling rock and then return the mantle to its proper position to maintain proper sizing. This system also provides the operator with an alarm against raising the mantle too high for safe operation and serves as a guide in determining liner wear for replacement purposes.

Motor load controllers and choke feed sensing mechanisms are used in automatic crushing control systems to maintain optimum throughput. In the case of one producer an investment of less than $2,500 resulted in an increase in crushing capacity of nearly 20%.

Automatic control of a shuttle conveyor or tripper car in the feeding of fine crushed ore to the storage silos or bins not only minimizes direct labour requirements but also maintains more uniform high-bin levels, thus minimizing the effects of segregation.

Many plants utilize systems to maintain both an optimum rate of feed to the grinding equipment and to maintain an optimum ratio of water-to-ore. In many cases the rate of feed is automatically and continually controlled on the basis of the grindability of the ore so as to maintain a maximum production from the grinding circuit.

A wide variety of systems is commonly used for controlling sump levels and which controls the interface position in thickeners and deslimers. One producer realized an increase of 1% par in the grade of his final product through the use of an interface control system which utilized a special interface detector.

These examples, it is suggested, are merely a few of the many control systems that can be successfully applied in the mineral dressing process to improve product quality and throughput and to minimize labour requirements. Similar benefits have been realized in modern plants for the pelletizing of iron-ore concentrates. Several large producers automatically control the ration addition of all additives such as coal and bentonite. Some of these plants also use control systems to automatically maintain a uniform and optimum bed level in the furnace.

All such control systems have proved over extensive periods of " on-stream " operation to be reliable and effective in maintaining high product.

Successful application of instrumentation and automatic control to the mineral dressing process requires, it is thought, not only an intimate knowledge of the process equipment and metallurgy but also time-tested experience with compatible measuring devices, instruments, and integrated control systems. Of particular importance is that measuring devices and instruments be selected not only on the basis of immediate requirements but also on their suitability for incorporation into complete control systems at a future date.

Any producer, earnestly seeking the benefits that can accompany properly-applied instrumentation and process control, might undertake some of these programmes :

(1) Visit existing mineral-dressing plants in which instrumentation and automatic control have been successfully applied. Discuss with these operators the applications that have produced the most significant results.

(2) Budget a certain amount of money for the upgrading of the present instrumentation.

(3) Set up a separate instrument department and make it responsible for all maintenance and repair work involving plant instrumentation.

(4) Undertake a detailed study of the " cause-effect " relationships for which you presently do not have the answers. Do this by making a complete analysis of data now being logged and, if necessary, get equipment for logging additional data needed.

(5) Watch for an opportunity to apply the so-called " optimizing approach." This control technique, in which the controller holds the process at an optimum condition rather than a pre-set condition, has great potential in the ore-processing industry.

Trade Paragraphs

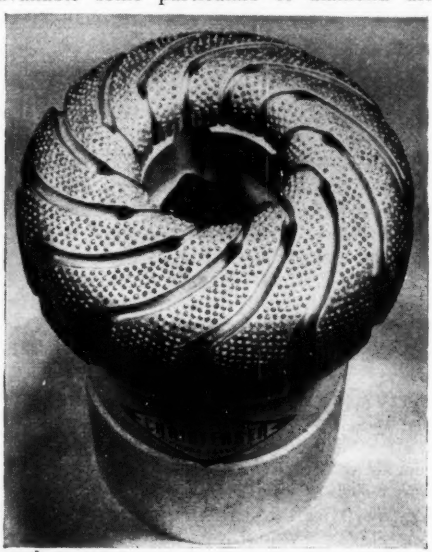
Simon-Carves, Ltd., of Cheadle Heath, Stockport, have received through their Canadian subsidiary a contract to supply a coal-preparation plant for the Crow's Nest Pass Coal Co. in British Columbia, capable of cleaning 120 tons per hour of *minus* ½ in. coal. It will be ready for commissioning in April, 1962.

Participating in the contract will be their subsidiary—the **Automatic Coal Cleaning Co., Ltd.,** of Carlisle—who will supply the jig washbox.

Earth Boring Machine Co., of Lake Works, Portchester, Hants, call attention to a tool which will interest soil samplers and prospectors by means of which a hole up to 2 ft. 6 in. deep and up to 10 in. diameter can be driven in soft

ground. The auger drill, as illustrated, is fitted with a 2½-h.p.Clinter air-cooled two-stroke engine.

Industrial Diamond Information Bureau, of 2, Charterhouse Street, London, E.C. 1, make available some particulars of diamond drill



material to be used in the Mohole project in which American scientists are engaged in drilling into the ocean bed. A typical drill crown supplied is shown in the accompanying illustration. There are some 2,500 stones in this 9-in. crown which will yield a 1¾-in. core for study.

Head, Wrightson and Co., Ltd., of 20, Buckingham Gate, London, S.W. 1., last month announced that their Australian subsidiary have received orders from The Broken Hill Proprietary Co., Ltd., and Australian Iron and Steel, Ltd., for the design, manufacture, and erection of a scree ore treatment plant, a basic oxygen steelmaking plant, and a tinplate cut-up line. The scree ore plant will treat 1,200,000 tons per year of deposits taken from the flanks of Iron Knob and have an output of 800,000 tons of concentrate averaging about 60% iron content.

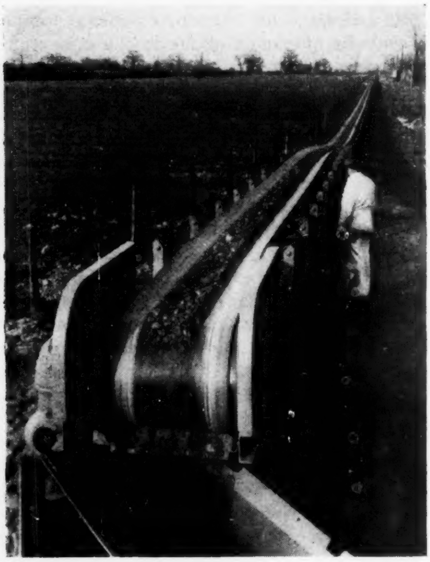
Yale and Towne Manufacturing Co., of Wednesfield, Staffs., recently invited representatives of the Press to see a demonstration of their equipment and to see these in course of manufacture. The particular purpose was to introduce the 204, a 2-cu. yd. four-wheel-drive tractor shovel of which an earlier model was described in the March, 1960, MAGAZINE. The 204 is a 12,000-lb. lifting capacity unit fitted with Leyland UE 350 engine, Allison torqmatic transmission, and planetary drive action axles, and has an additional 1,000 lb. counter weight added to improve stability and weight distribution between axles.

Holman Bros., Ltd., of Camborne, with their subsidiary company Climax Rock Drill and Engineering Co., Ltd., have supplied mining and civil engineering equipment to Russia for a number of years. Both companies, then acting independently were carrying on a brisk trade with Russia in the early 1930's. At the current Moscow Trade Fair they are showing the Holtrac crawler-mounted drill rig, which, with a towed air-compressor mounts an SL. 160 heavy drifter, the Rotair 370 portable rotary-screw compressor delivering 370 c.f.m. at 100 p.s.i., three examples of their rock-drills including the record-breaking Silver Three, and the dryductor rock-drill.

J. D. Tractors, Ltd., of Maidenhead Road, Windsor, Berks., recently gave a demonstration of the John Deere–Lanz ⅞ cu. yd. crawler loader known as the Ten-Ten, manufactured by John Deere–Lanz A. G., of Mannheim. Principal features are the 40-h.p. "oversquare" diesel engine which gives a wide range of operating speeds, the Revers-a-Matic drive which obviates the necessity for declutching when changing from forward to reverse, a

single lever control for the bucket, and the bucket level indicator. All movements, in fact, are hydraulically operated and controlled. Other units are expected to be available shortly and some further notes will follow.

Imperial Chemical Industries, Ltd., of Imperial Chemical House, Millbank, London, S.W. 1, issue a note on Terylene-cotton belting in reference to the photograph reproduced here of a conveyor-belt over 2,000 ft. long which is carrying 200 tons of sand and gravel per hour as an example of the strength of such belting. The belt shown is made from a 4-ply Terylene-cotton fabric, is rubber covered, and was manufactured by **Barrow, Hepburn, and Gale, Ltd.,** of Mitcham, Surrey, and the conveyor



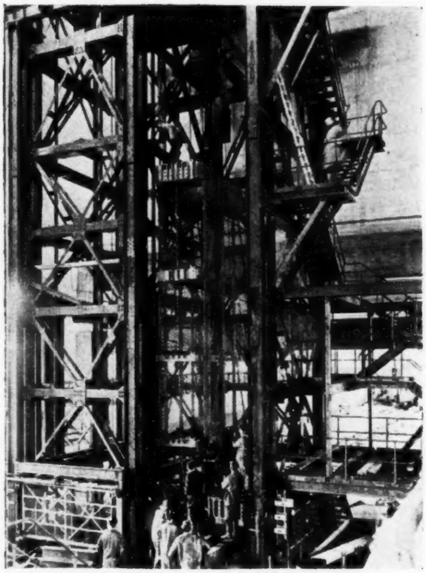
installation was redesigned by the **Mining Engineering Co., Ltd.,** of Worcester to take full advantage of the strength and flexibility of the new material in such a way that three belts and two transfer points have now been replaced by this one unit.

General Electric Co., Ltd., of Erith, Kent, have received a repeat order from the East Rand Engineering Co. of Johannesburg for equipment to be used in the conversion of a winder from steam to electric drive which will be installed underground at the Withok mine of the South Africa Land and Exploration Co., Ltd., in the Anglo American Group. Twin 6·6-kV. 1,150-h.p. 10-pole a.c. motors will be used to drive the 12 ft. by 5 ft. double-drum winder which will be fitted with the company's latest closed-loop a.c. speed-control equipment. Another notice from the company refers to an order received by Fraser and Chalmers Engineering Works from the Anglo American Corporation of South Africa, Ltd., for two complete double-drum winding engines. They are for the main sub-incline shaft of Bancroft Mines, Ltd., Northern Rhodesia, and will be installed in an underground chamber approximately 1,150 ft. below the surface. One will be for handling rock and the other for men and materials. The mechanical parts will be identical. Each drum will be 11 ft. in diameter and 4 ft. wide, and the engines will be fitted with low-pressure oil-operated brakes. They will be driven through single-reduction gears by 11-kV. three-phase 1,440-h.p. 570 r.p.m. motor. Both will be fitted with a.c. closed-loop speed control.

Knapp and Bates, Ltd., of Finsbury Court, Finsbury Pavement, London, E.C. 2, have recently announced that they can now offer the Hartford system of fine sizing. The procedure involved depends on producing a fluid state in the material being handled, a state which can be induced by velocity, vibration, by a current of gas or liquid through the mass of particles, or by any combination of the three methods. In such a state the fluidized mass materially aids gravity separation of mineral particles. This new approach to fine-sizing techniques, can, it is claimed, often provide successful results in circumstances in which conventional screens show low efficiencies, need too much area, or are subject to blinding. Even moist material may be handled without the need either to dry or to add more water. Sizing down to the 100-micron range can be successfully achieved. Blinding is eliminated, since the aperture diameter is always at least six times the diameter of the largest particle.

The company states that it will be pleased to examine samples and carry out amenability tests for interested clients, or to quote for an extended programme of test work on favourable terms in cases where this is desirable. The only stipulation is that samples should be submitted " in exactly the state in which they would have to be handled."

Markham and Co., Ltd., of Chesterfield, recently afforded an opportunity of visiting their works and inspecting various items of a wide range of equipment in process of manufacture. The company has for many years specialized in the design and fabrication of mining equipment, principally for collieries. Over 200 steam and electric winders, ranging from 500 h.p. to 5,000 h.p., have been produced



Cage Erection at Rothes Colliery.

and installed in the United Kingdom and overseas. A project recently completed is that of producing the surface machinery, including three friction winders, mine car circulation systems, cages, and shaft equipment for the National Coal Board at Rothes colliery, Fife, the accompanying illustration showing cage erection and the guide framing at that property. Two of the largest four-rope friction winders made, with a drum diameter of 16 ft. and working to a final depth of nearly 4,000 ft., with a winding capacity of 450 tons per hour, have also been manufactured and recently installed at Wolstanton colliery, as have the two towers and friction winders at the new National Coal Board colliery at Bevercotes. The company has also developed special-purpose machinery for the disposal of stone and other debris underground and to control an allied problem in mining areas, that of surface subsidence, typical underground equipment produced including pneumatic stowing machines of various types. Ancillary equipment produced for pneumatic stowing purposes includes tipplers for handling pit tubs and mine cars and plant for preparing waste rock to suitable dimensions with pipeline items and other special details.

In a parallel field tunnelling shields, air locks, and other plant for the driving of tunnels in types of soil where these techniques are appropriate, are also among the company's specialities. Notable examples include the Mersey tunnel, the Dartford-Purfleet tunnel, the Moscow underground railway, and most of the underground railway tunnels in London. Markham's equipment has also been used for tunnelling schemes in France, Italy, and the West Indies.

Engineering, Marine, Welding and Nuclear Energy Exhibition

Notes follow on some items of interest seen at the exhibition, following the advance particulars given in the April issue :—

Austin Motor Co. Ltd., of Longbridge Works, Birmingham, were showing a 250-b.h.p. gas turbine designed for industrial use. This has a single-shaft turbine rotor running at 29,000 r.p.m. with a reduction gearbox bringing the output shaft speed to 1,500 r.p.m. In one form it is coupled to a 160-kW alternator giving 200 kVA at 0·8 power factor, or it may be used for driving a pump.

Fluidrive Engineering Co. Ltd., of Isleworth, Middx., showed several examples of the Vulcan-Sinclair fluid coupling as well as models to demonstrate particular features of various types. Attention was called to certain applications—as, for instance, to the driving heads of belt-conveyor installations at Nchanga Copper Mines, where there are 27 units some of which have 48-in. belts of more than 4,000 ft. in length running at 800 f.p.m. Another example mentioned is of a ball-mill drive (600 h.p.) at Barvue Mine, Northern Quebec.

W. C. Holmes and Co., Ltd., of Turnbridge, Huddersfield, were showing a range of dust collection and control plant, including the Holmes-Elex electrical precipitator, the Holmes-Schneible multi-wash collector, and Holmes-Rothemuhle multi-cell cyclone dust collectors.

International Combustion Group of Companies, of 19 Woburn Place, London, W.C. 1, had on their stand some examples of their screening, pumping, and filtering equipment—notably, the Ty-Rocket screen for rapid treatment of slurries, the Dynoscreen continuous screen-type centrifuge, and two types of Vacseal pumps.

Keith Blackman and Co., Ltd., of Mill Mead Road, London, N. 17, demonstrated the type PS elevator which is essentially a pneumatic syphon system in which fine and coarse granular materials in a fluidized state are elevated The basic principle of the system is that the granular particles, whatever their size, shape, density, or condition, can be made to flow when fluidized provided there is a pressure differential between starting and finishing points irrespective of the relative positions of these points and

the path between them. While the pressure differential is created and maintained artificially—*i.e.*, the suction side of a fan or compressor—the natural forces of gravity and atmospheric pressure are employed for the actual elevation of the materials.

Perkins Gas Turbines, Ltd., of Peterborough, who were showing examples of the Perkins Mars gas turbines which included an instructional and test unit point out that the photograph reproduced in the April issue illustrated a d.c. generator set with 30 kW output.

Tangyes, Ltd., of Smethwick, Birmingham, featured their Hydraflo pumps, of which four have been ordered for the Dutch State Mines for deep-hole infusions and for use in connexion with the operations of hydraulic-controlled roof supports.

NEW BOOKS, PAMPHLETS, ETC.

Publications referred to under this heading can be obtained through the Technical Bookshop of *The Mining Magazine*, 482, Salisbury House, London, E.C. 2.

The Platinum Metals : Canadian Mineral Resources Division Mineral Report 3. By C. C. Allen. Paper covers, 68 pages, illustrated. Price $1.00. Ottawa : Department of Mines and Technical Surveys.

Association of Mine Managers of South Africa : Papers and Discussions, 1958–1959. Cloth, octavo, 1,119 pages, illustrated. Johannesburg : The Transvaal and Orange Free State Chamber of Mines.

Summary Review of Federal Taxation and Legislation Affecting the Canadian Mineral Industry : Canadian Mineral Resources Division Mineral Information Bulletin MR 42. Compiled by E. C. Hodgson. Paper folio, typescript, 30 pages. Price 50 cents. Ottawa : Department of Mines and Technical Surveys.

A Survey of the Petroleum Industry in Canada, 1959 : Canadian Mineral Resources Division Mineral Information Bulletin MR 48. By R. A. Simpson, D. M. Nowlan, and D. W. Rutledge. Paper folio, typescript, 82 pages, illustrated. Price 50 cents. Ottawa : Department of Mines and Technical Surveys.

Metal and Industrial Mineral Mines in Canada, 1960 : Canadian Mineral Resources Division Operators List 2. Paper covers, 27 pages. Price 25 cents. Ottawa : Department of Mines and Technical Surveys.

Milling Plants in Canada : Metallic Ores, 1960 : Canadian Mineral Resources Division Operators List 3, Part I. Paper covers, 45 pages. Price 25 cents. Ottawa : Department of Mines and Technical Surveys.

Somaliland Protectorate : Geological Survey Report No. 3. Geology of the Las Khoreh-Elayu Area, Erigavo District (Quarter Degree Sheets Nos. 5 and 6). By J. E. G. W. Greenwood. Paper boards, 36 pages, illustrated, with maps. Price Shs. 20/–. London : Crown Agents for Oversea Governments and Administrations.

Conference on Coal-Burning Gas Turbines : McGill University, Montreal, Nov. 22–23, 1956. Proceedings. Paper covers, 269 pages, illustrated. Price $2.00. Ottawa : Dept. of Mines and Technical Surveys.

6th Commonwealth Mining and Metallurgical Congress, Canada, 1957. Proceedings. Cloth, folio, 154 pages, illustrated. Vancouver : Western Miner Press, Ltd.

The Clover Bar Coal Zone, Edmonton–Morinville District, Alberta. Research Council of Alberta Preliminary Report 61—1. By G. Raymond Pearson. Paper folios, 26 pages, illustrated, with map. Price 50 cents. Edmonton : Research Council of Alberta.

The South Wales Story of the Association of Mining Electrical and Mechanical Engineers. By Dafyad Tomos. Paper folio, 44 pages, illustrated. Price 5s. Cardiff : Secretary A.M.E.M.E., 55, Churchill Way.

RECENT PATENTS PUBLISHED

A copy of the specification of the patents mentioned in this column can be obtained by sending 3s. 6d. to the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. 2, with a note of the number and year of the patent.

454 of 1956 (863,805). G. F. Eveson. Removing shale particles from coal or from coal-washing effluent by froth flotation.

24,414 and 35,567 of 1957 (863,620 and 863,310). E. I. Du Pont de Nemours and Co. Production of Ti, Nb, Ta, Mo, V, or W.

32,136 of 1957 (862,589). Badische Anilin-u. Soda-Fabrik A.G. Sedimentation processes.

11,454 of 1958 (862,530). Hischmann Geb. Process and apparatus for drying crushed material in a crushing and screening plant.

24,485 of 1958 (862,142). E. Weichel. Spreading material from the discharge end of a pneumatic conveyor.

29,492 of 1958 (863,311). Co. des Metaux d'Overpelt-Lommel et de Corphalie. Treatment of ores or like materials.

8,947 of 1959 (863,786). Co. des Metaux d'Overpelt-Lommel et de Corphalie. Reduction of zinc ores and other zinc-bearing materials.

16,601 of 1959 (862,719). Dow Chemical Co. Separation of suspended solids.

32,107 of 1959 (863,428). Dow Chemical Co. Production of titanium metal.

Selected Index to Current Literature

This section of the Mining Digest is intended to provide a systematic classification of a wide range of articles appearing in the contemporary technical Press, grouped under heads likely to appeal to the specialist.

* Article in the present issue of the MAGAZINE. † Article digested in the MAGAZINE.

Economics

***Industry, Mining :** *Congress, S. Africa.* The Congress in Africa. THE MINING MAGAZINE, May, 1961.

Mining, Canada : *Prospects, Review.* Problems and Prospects of the Canadian Mineral Industry. M. BOYER, *Western Miner,* Mar., 1961.

Production, Africa : *Gold, S. Rhodesia.* Mines History No. 21—Mazoe. *S. R. Chamber of Mines J.,* Feb., Mar., 1961.

Production, France : *Iron, Lorraine.* The Probable Lines of Development of the Iron and Steel Industry in the Lorraine. M. EPRON, *Rev. Ind. Miner.,* Mar., 1961.

Production, United States : *Uranium, Wyoming.* Ore Requirements Push Expansion of Frazier-Lamac Pit. J. R. BOGERT, *Min. World* (San Francisco), Apr., 1961.

Resources, Nepal : *Minerals, Review.* Nepal. J. E. O'ROURKE, *Min. World* (San Francisco), Apr., 1961.

Resources, United States : *Beryllium, Colorado.* New Beryllium Discoveries on Colorado's Badger Flats. J. SIMMONS, *Min. World* (San Francisco), Mar., 1961.

Geology

Control, Ore : *Pipes, Breccia.* The Significance of Mineralized Breccia Pipes. V. D. PERRY, *Min. Engg.,* Apr., 1961.

Control, Ore : *Studies, Australia.* Ore Localization by Preconsolidation Structures. J. ELLISTON, *Proc. Aust. Inst. Min. Metall.,* Dec., 1960.

Economic, Peru : *Sulphides, Cerro de Pasco.* The Pyrite Body and Copper Orebodies, Cerro de Pasco Mine, Central Peru. H. J. WARD, *Econ. Geol.,* Mar.–Apr., 1961.

†Economic, S. Africa : *Bitterfontein, Cape.* The Geology of the Bitterfontein Area, Cape Province. H. JANSEN, S. Afr. Geol. Survey Explanation of Sheet 253.

Economic, United Kingdom : *Coal, Yorkshire.* Tracing the Boundary of the Concealed Coalfield of Yorkshire Using the Gravity Method. J. T. WHETTON and others, *Min. Engr.,* May, 1961.

Economic, United States : *Uranium, Colorado.* Vanadium-Uranium Deposits of the Rifle Creek Area, Garfield County. R. P. FISCHER, *U.S. Geol. Surv. Bull.* 1101.

Economic, United States : *Uranium, Washington.* Uranium Mineralization at the Midnite Mine, Spokane. J. BARRINGTON, P. F. KERR, *Econ. Geol.,* Mar.–Apr., 1961.

Exploration, Drilling : *Transport, Air.* Air Transport in the Diamond Drilling Industry. C. V. GODWIN, *Canad. Min. J.,* Mar., 1961.

***Mineralogy, Economic :** *Pollucite, Identification.* The Identification of Pollucite. K. F. G. HOSKING, THE MINING MAGAZINE, May, 1961.

Mining, United States : *Use, Butte.* The Role of the Geologist at Butte. E. P. SHEA, *Min. Engg.,* Mar., 1961.

Regional, Africa : *Lake Victoria, Kenya.* The Geology of Mfwanganu Island. T. WHITWORTH, *Overseas Geol. Min. Res.,* Vol. 8, No. 2.

Regional, Solomon Islands : *Survey, Santa Isabel.* Explanatory Notes to Accompany a First Geological Map of Santa Isabel. R. L. SWANTON, *Overseas Geol. Min. Res.,* Vol. 8, No. 2.

Survey, Aerial : *Interpretation, Photo.* Aerial Photographs in Geologic Interpretation and Mapping. R. G. RAY, *U.S. Geol. Surv. Prof. Paper* 373.

Survey, Geochemical-Geophysical : *Sulphides, Canada.* The Murray Deposit, Restigouche County, N.B. H. W. FLEMING, *Canad. Min. Metall. Bull.,* Mar., 1961.

Survey, Geophysics : *General, Canada.* An Empirical Demonstration of Geophysical Methods Across the Caribou Deposit, Bathurst, N.B. J. D. CORBETT, *Canad. Min. Metall. Bull.,* Mar., 1961.

Metallurgy

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